1. OVERVIEW

Subject area	Quantum Physics I
Degree	Bachelor's Degree in Physics
School/Faculty	School of Architecture, Engineering and Design
Year	Third
ECTS	6
Type	Compulsory
Language(s)	Spanish
Delivery mode	On campus
Semester	S5

2. INTRODUCTION

The main aim of this subject area is to provide students with a solid introduction to the postulates and mathematical formalism of quantum physics. In particular, to justify the need for quantum theory, it includes a historical introduction to how certain aspects of the physical world cannot be sufficiently described using classical mechanics. The quantum systems that will be analysed in this subject area, of huge important in later years of the degree, include the quantum harmonic oscillator and the hydrogen atom.

3. SKILLS AND LEARNING OUTCOMES

Key skills (CB, by the acronym in Spanish):

- CB4: Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

- CG1: To understand key concepts, methods and findings in the different branches of physics while gaining a historical perspective of their development.

- CG5: To understand diverse phenomena that, despite being physically different, share certain similarities, allowing known solutions to be applied to new problems.

Transversal skills (CT, by the acronym in Spanish):

- CT5: Problem solving: Be able to critically evaluate information, separate complex situations into their constituent parts, recognise patterns, and consider alternatives, different approaches and perspectives in order to find optimal solutions and negotiate efficiently.
- CT6: Adaptability: Being able to accept, appreciate and integrate different positions, being able to adapt one's own approach as required by the situation, as well as working effectively in ambiguous situations.

Specific skills (CE, by the acronym in Spanish):

- CE02: To describe and analyse physical systems, identifying fundamental concepts and principles to make the approximations needed to build a simplified model.
- CE03: To understand the inherent limitations of classical physics that led to the emergence of the general and special theories of relativity and quantum mechanics, resulting in solutions to new physics problems.
- CE04: To understand the laws and principles of physics, to identify their logical and mathematical structure, their experimental basis and the phenomena described through them.

Learning outcomes (RA, by the acronym in Spanish):

- RA1: To use the experimental foundations of quantum physics together with its body of postulates to properly discuss laboratory experiences and/or exercises.
- RA2: To correctly apply the mathematical formulation of quantum mechanics in simple one-dimensional and three-dimensional systems to successfully complete the practical activities.
- RA3: To understand the basic elements of the general theory of angular momentum, specifically in relation to orbital and spin angular momentum, for the study of basic atomic properties.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CB4, CG1, CG5, CT5, CE02, CE03, CE04	RA1

CB4, CG5, CT5, CE02, CE04	RA2
CB4, CG5, CT5, CT6, CE02, CE04	RA3

4. CONTENTS

1. Background: experimental foundations of quantum physics.
2. Schrödinger equation.
3. Postulates and mathematical formalism.
4. One-dimensional problems.
5. Three-dimensional problems.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Collaborative learning: Students learn to collaborate with other people (classmates and professors) in order to find creative, comprehensive and constructive solutions to questions and problems that arise from the given case studies, using all relevant knowledge and material resources available.

- Problem-based learning: Students are given problems and asked to solve them, working individually or in groups.

- Lectures: Presentations by the professor with the necessary technological tools to maximise comprehension of the learning content.

- Guided academic activities: Individual and group work that is more independent, including information searches, written summaries, debates and the public defence of projects.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity	Number of hours
Lectures	33
Asynchronous lectures	12
Report writing	13.5

Assessment	6
Practical activities (problems, projects, workshops and/or lab work)	21
Group tutorials	10
Independent working	54.5
TOTAL	**150**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
SE1. Individual on-campus knowledge tests (theory and/or practice)	50%
SE2. Oral defence	5%
SE3. Submission of group and/or individual reports, written work, projects or exercises	30%
SE4. Performance observation	15%

On the Virtual Campus, when you open the subject area, you'll find details of your assessable tasks, including the submission dates and assessment procedures for each task.

8. BIBLIOGRAPHY

The recommended bibliography is indicated below:

- Sánchez del Río, C. *"Física Cuántica"*. Pirámide (2020).
- Cohen-Tannoudji, C. et al. *"Quantum Mechanics (Volume I and II)"*. Wiley (2019).

- Isham, C. J. *"Lectures on Quantum Theory: Mathematical and Structural Foundations"*. Imperial College Press (1995).