Universidad Zaragoza

Academic Year/course: 2023/24

26921 - Quantum Physics I

Syllabus Information

Academic year: 2023/24
Subject: 26921 - Quantum Physics I
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 7.0
Year: 3
Semester: First semester
Subject type: Compulsory
Module:

1. General information

This subject is the first of the Structure of Matter module of the Physics degree and its objective is to provide the student with a broad vision of the physical phenomena associated with Quantum Physics, its methods and applications and its relationship with related subjects. The objectives are shared with Quantum Physics II.

These approaches and objectives are aligned with the Sustainable Development Goals (SDGs) of the 2030 Agenda of United Nations (https://www.un.org/sustainabledevelopment/es/) so that the acquisition of the learning results of the subject provides training and knowledge, skills and competencies to contribute to some extent to the achievement of Goals 1,3,7 and 9.

2. Learning results

- Relate the photoelectric effect, blackbody radiation, the Compton effect, pair production and the Bohr model in the quantum description of physical systems
- Solve rectangular potential wells (finite and infinite) in one dimension and interpret the solution from a quantum point of view
- Solve potentials with spherical symmetry, in particular the hydrogen atom.
- Calculate the probabilities of measurement of an observable in a wave function.
- Composing angular moments and handling the Clebsch-Gordan coefficient tables.

3. Syllabus

1. Introduction: What is Quantum Physics and why study it?
2. Origins of quantum theory: corpuscular properties of waves.
3. Wave properties of free particles: atomic models and de Broglie's hypothesis.
4. Particles subjected to external conservative forces: Schrödinger equation. Simple examples in one dimension.
5. Quantum harmonic oscillator.
6. Dirac Formalism. State space. Bras and kets. Postulates of Quantum Mechanics.
7. Physical content of the quantum formalism.
8. Angular momentum. Central potentials. Hydrogen atom.
9. Addition of angular momentum. Clebsch-Gordan coefficients.

4. Academic activities

- Theory classes (45 hours): The contents of the subject will be presented
- Problem classes (15 hours): Problems related to the previous contents will be solved.
- Laboratory practice (10 hours): There will be 4 practices in 2 laboratory sessions dedicated to the observation, analysis and experimental measurement of quantum phenomena.
- Personal study and work (100 hours): 86 hours of study and problem solving and 14 hours of writing of laboratory practice reports.
- Evaluation tests (5 hours): The comprehensive exams will be held on the dates indicated by the Faculty of Science.

5. Assessment system

Each student will be able to choose between face-to-face and non-face-to-face modalities.

Face-to-face mode (30% continuous evaluation and 70% written exam):

a) Continuous evaluation (3 points total):

1. Laboratory practices (2 points): The laboratory work will be done in pairs. The report of the lab results of will be evaluated by means of a 15-minute individual public presentation.

2. Solving problems assigned in class (1 point).

The student who does not take the practical exam or does not hand in all the assigned problems will be evaluated in the non-face-to face mode However, they may choose to save the separate grade for practices or problems, if any.

b) Written examination (7 points): Problems and theory questions to be solved during approximately 3.5 hours.

Non-attendance mode: A single comprehensive test consisting of two examinations.

- Same written exam as for on-site students (7 points)

- Additional exam (1.5 hours, 3 points total) that will contain a question on laboratory practices (2 points) and problems or questions based on the collection of problems used in class (1 point).