SUBJECT TEACHING GUIDE

G1998 - Atomic and Molecular Physics

Double Degree in Physics and Mathematics
Degree in Physics
Degree in Physics

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Physics Degree in Physics			Type and Year	Compulsory. Year 3 Compulsory. Year 3
Faculty	Faculty of Sciences				
Discipline	Subject Area: Quantum Physics and the Structure of Matter Central Module				
Course unit title and code	G1998 - Atomic and Molecular Physics				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA MODERNA
Name of lecturer	FRANCISCO MATORRAS WEINIG
E-mail	francisco.matorras@unican.es
Office	IFCA - Edificio Juan Jordá. Planta: - 1. DESPACHO (S107)
Other lecturers	JOSE IGNACIO GONZALEZ SERRANO

3.1 LEARNING OUTCOMES
- Understand the relevance of quantum physics in the microscopic interpretation of physical phenomena
- Understand the difference between fermionic and bosonic systems.
- Know the Bohr model of the hydrogen atom. write and solve the Schrödinger equation for the hydrogen atom. Understand the role of angular momentum and spin
- Understand the concept of identical particles and apply it to the the helium atom case.
- Know the basic notions about multielectronic atoms. Apply the central field approximation

4. OBJECTIVES
Acquire a global vision of the quantum description of atoms.
Understand the Schrödinger equation for the hydrogen atom: angular momentum, spherical harmonics. Obtain and interpret the solutions: energy levels, wave functions.
Understand the extension to other hydrogen atoms.
Acquire a vision of the relativistic equation: Dirac equation, concept of spin, fermions and bosons, Pauli exclusion principle.
Learn the fundamentals of the radiative transitions
Learn the fine and hyperfine corrections to Schrödinger equation for the hidrogen atom
Understand the interaction with electrical and magnetic fields
Quantum description of multielectronic atoms: Helium
Learn about applications of quantum technologies in the field

6. SUBJECT PROGRAM	
CONTENTS	
1	One electron atoms
2	Dirac equation, spin.
3	Radiative transitions
4	fine and hyperfine structure
5	Interactions with fields
6	Systems of particles: indistinguishably and entanglement
7	two electron atoms
8	Multielectronic atoms
9	Quantum techmologies

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
four short quizzes at the end of the different blocks	Others	No	Yes	40,00
final exam: Theoretical questions and practical problems	Written exam	Yes	Yes	60,00
TOTAL				100,00
Observations				
The mark will be calculated as the best of the final exam and the average of the quizzes (40%) and the exam (60%).				
Observations for part-time students				

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
B.H. Bransden, C.J. Joachain, The Physics of Atoms and Molecules (Longman, 2003)