

## SUBJECT TEACHING GUIDE

### G1998 - Atomic and Molecular Physics

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

Academic year 2022-2023

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics 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 an overview 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 hydrogen atom

Understand the interaction with electrical and magnetic fields

Quantum description of multielectronic atoms: Helium

Periodical properties of elements

#### 6. COURSE ORGANIZATION

##### CONTENTS

1	One electron atoms
2	Dirac equation, spin.
3	Radiative transitions
4	fine and hyperfine structure
5	Interactions with fields
6	2-electron atoms
7	Multielectronic atoms
8	Periodic Properties

#### 7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Quiz	Others	No	Yes	40,00
final exam: Theoretical questions and practical problems	Written exam	Yes	Yes	60,00
<b>TOTAL</b>				<b>100,00</b>
Observations				
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)

