SUBJECT TEACHING GUIDE

G2001 - Molecular and Solid Structures

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	G2001 - Molecular and Solid Structures				
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. CIENCIAS DE LA TIERRA Y FISICA DE LA MATERIA CONDENSADA
Name of lecturer	PABLO GARCIA FERNANDEZ
E-mail	pablo.garciafernandez@unican.es
Office	Facultad de Ciencias. Planta: + 2. DESPACHO PROFESORES (2007)
Other lecturers	

3.1 LEARNING OUTCOMES

- Understanding the relevance of quantum physics in the microscopic intrepretation of physical phenomena.
- Understanding the electromagnetic radiation and its interaction with matter at a quantum level.
- Understanding the use of symmetry in quantum systems
- Knowing the basic spectroscopic techniques for structural and dynamical characterization of molecules
- Knowing how to analyze the structure of crystals, their stability and associated physical properties
- Knowing the simple models describing the vibrations in solids and their associated properteis
- Understanding experimental results in solids and obtaining vibrational, electronic and magnetic parameters from basic models

4. OBJECTIVES

Having a global vision of the microscopic structure of matter, starting with the electronic structure of atoms to understand the formation of molecules and solids.
Understanding the independent particle model in molecules and the antisymmetrization of the wavefunction, the Hartree-Fock equations and the exchange energy.
Understanding the importance of symmetry in quantum mechanics.
Having a basic knowledge of spectroscopic techniques and being able of analyzing the rotational and vibrational dynamics in molecules.
Being able to analyze and understand the microscopic origin of many macroscopic properties.
Having a basic knowledge of crystalline solids, their symmetries and their dispersion curves.
Understanding the concepts and basic models for the structure of matter, including their approximations and limitations as well as the orders of magnitude of these properties.
Having a basic knowledge of the basic techniques for the characterization of materials, particularly X- ray diffraction and basis spectroscopic methods.

6. SUBJECT PROGRAM

CONTENTS	
1	Structure of molecules and solids, crystallography
2	Reciprocal lattice, X-ray diffraction
3	Electronic structure of molecules
4	Symmetry
5	diatomic molecules
6	Polyatomic molecules and intermolecular bonds
7	Spectroscopy: Rotations, vibrations and electronic transitions
8	Vibrations in solids and thermal properties
9	Compulsory spectroscopy/vibrations in solids evaluation in final exam

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Test (part 1)	Written exam	No	Yes	30,00
Test (part 2)	Written exam	No	Yes	30,00
Spectroscopy hand-out	Work	No	No	10,00
Spectroscopy evaluation	Written exam	Yes	Yes	30,00
TOTAL				100,00

Observations

- Test 1 (30%, minimum score 4/10): October
- Test 2 (30%, minimum score 4/10): November
- Spectroscopy hand-out (10%) December
- Ordinary exam includes compulsory evaluation of spectroscopy (30%, minimum score 2.5) + reevaluation of previous exams (only if not positively evaluated before)
- Extraordinary exam: Full content of the course

Observations for part-time students

The teachers will try, as much as possible, help students to follow the course. The evaluation will consist of a final exam (90%) and the spectroscopy hand-out (10%)

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

P. W. Atkins, Molecular Quantum Mechanics (Oxford U.P., 1993).
M. T. Dove, Structure and Dynamics. An Atomic View of Materials (Oxford U.P., 2003).
N. W. Ashcroft, N. D. Mermin, Solid State Physics (Holt, Rhinehart and Winston, 1976)