

SUBJECT TEACHING GUIDE

G70 - Physics of Materials

Double Degree in Physics and Mathematics Degree in Physics

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Physics			Type and Year	Optional. Year 5 Optional. Year 4
Faculty	Faculty of Sciences				
Discipline	Subject Area: Physics of Materials Mention in Fundamental Physics				
Course unit title and code	G70 - Physics of Materials				
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	FERNANDO AGUADO MENENDEZ				
E-mail	fernando.aguado@unican.es				
Office	Facultad de Ciencias. Planta: + 2. DESPACHO PROFESORES (2009)				
Other lecturers	FERNANDO RODRIGUEZ GONZALEZ CESAR MORENO SIERRA VIRGINIA MONTESEGURO PADRON				

3.1 LEARNING OUTCOMES

- To review the most powerful techniques for the synthesis of materials
- To establish the techniques for the analysis of materials
- To study current materials grouped by their macroscopic properties
- To establish the interest of current materials from the applications point of view
- To establish the interest of research and development of materials in today's society
- Connections with biological materials and chemical synthesis

4. OBJECTIVES

- Being able to classify materials according to their structure and physical properties.
- To know physical models enabling to understand a wide variety of materials properties.
- To measure physical properties in different types of materials.
- To gain an ample background of knowledge and skillness in different experimental techniques and apparatuses of common use in research laboratory and industry.
- To study technical reports about a complex instrument, being able to apply it to new measurements.

6. COURSE ORGANIZATION

CONTENTS

1	Topic 1 Introduction. Types and classification of materials. Relationship between structure and physical properties. Size effects and quantum confinement. Nanometric materials.
2	Topic 2 Dielectric and Optical Properties of materials. Insulators, Semiconductors and Metals. Complex refractive index. Absorption and Reflection of light by Materials. Absorption and luminescence processes in solids. Configurational coordinate energy diagrams. Relevant Optical and Dielectric phenomena.
3	Topic 3 Laboratory works: Microscopic techniques for materials analysis and characterization Optical absorption spectroscopy: electronic structure of insulators and semiconductors. Emission/excitation spectroscopy: Photoluminescent materials.
4	Topic 4 Electrical properties of materials. Insulators, Metals and Semiconductors. Band structure and conductivity. Applications. 2D and nanostructured materials
5	Topic 5 Magnetic properties of materials. Magnetic phenomena: microscopic description. Diamagnetism, Paramagnetism and Ferromagnetism. Other magnetic structures: structural characterization. Applications. Spintronics and Nanomagnetism
6	Topic 6 Functional materials. Structure and physical properties. Elasticity, Pyroelectricity and Piezoelectricity. Applications. Multifunctional materials. Interplay between properties and types of materials.
7	Topic 7 Laboratory works: Macroscopic techniques for analysis and characterization of materials. Magnetic susceptibility measurement in different types of materials. Characterization of ferroelectric materials. Temperature effects.
8	Topic 8 Superconductivity. Experimental phenomena and characterization of superconductors. BCS theory. Predictions and new superconductor materials. Experimental work: magnetic levitation.

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Reports on practical works	Work	No	No	50,00
Final written exam	Written exam	Yes	Yes	5,00
Control exam of topics 1-2	Written exam	No	Yes	20,00
Control exam of topics 4-5	Written exam	No	Yes	12,50
Control exam of topics 6	Written exam	No	Yes	12,50
TOTAL				100,00
Observations				
<p>The student must carry out 4 lab sessions (Topics 3 and 7) and write the corresponding reports. The evaluation of each laboratory work will consist of 1) the report (80%) and 2) laboratory work (20%). The latter evaluation consists of a personal and continuous tracking about queries and attitude of the student in the laboratory. Laboratory work is mandatory. The final grade will be the weighted average of grades obtained from laboratory works and exams.</p>				
Observations for part-time students				
Professors will try to make easy part-time students to follow the course program. Laboratory work is mandatory in any case.				

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
Temas 1-8 R. J. Naumann, Introduction to the Physics and Chemistry of Materials, CRC Press, Boca raton (2009).
Temas 1,2,3,6 M. Fox, Optical Properties of Solids, Oxford University Press, Oxford (2001).
Temas 1,4-8 K. H. J. Buschow and F. R. De Boer, Physics of Magnetism and Magnetic Materials, Kluwer (2003).