VNIVERSITAT DE VALÈNCIA

Course Guide
44425 Nanomagnetism and molecular spintronics

COURSE DATA

Data Subject	
Código	44425
Name	Nanomagnetism and molecular spintronics
Cycle	Master's degree
ECTS Credits	4.5
Curso académico	2018 - 2019

Study (s)

Degree	Center	Acad. year	Period
2208 - M.U. en Nanociencia y Nanotecnolog²a Molecular	FACULTY OF CHEMISTRY	1	First term

Subject-matter

Degree	Subject-matter	Character
2208 - M.U. en Nanociencia y Nanotecnolog²a Molecular	9 - Nanomagnetism and molecular spintronics	Obligatory

Coordination

Name	Department
CORONADO MIRALLES, EUGENIO	320 - QUđMICA INORGĆNICA

SUMMARY

The general aim of the course is to provide the students with a coherent and modern education of a wide range of fundamental, methodological and technological aspects on nanomagnetism and molecular spintronics.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

There are no specified enrollment restrictions with other subjects of the curriculum.

OUTCOMES

2208 - M.U. en Nanociencia y Nanotecnología Molecular

- Students can apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
- Students are able to integrate knowledge and handle the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflection on social and ethical responsibilities linked to the application of their knowledge and judgments.
- Students have the learning skills that will allow them to continue studying in a way that will be largely self-directed or autonomous.
- Students have the knowledge and understanding that provide a basis or an opportunity for originality in developing and/or applying ideas, often within a research context.
- To possess the necessary knowledge and abilities to continue with future studies in the PhD program in Nanoscience and Nanotechnology.
- For students from field of knowledge (e.g. chemistry) to be able to scientifically communicate and interact with colleagues from another field (e.g. physics) in the resolution of problems laid out by the Molecular Nanoscience and Nanotechnology.
- To acquire the basics knowledge in fundamentals, use and applications of microscopic and spectroscopic techniques used in nanotechnology.
- To assess the relationships and differences between the materials macroscopic properties and those of unimolecular systems and nanomaterials.
- To assess the molecules and hybrid materials relevance in electronics, spintronics and molecular nanomagnetism.
- To know the main molecular nanomaterials technological applications and to be able to put them in the Material Science general context.
- To know the main applications of nanoparticles and nanostructured materials obtained or functionalised using a molecular approach- in magnetism, molecular electronics and biomedicine.

LEARNING OUTCOMES

- To acquire the basic knowledge as well as the overall view of the principal research lines of the Nanomagnetism area, including electronic, magnetic and transport properties of low dimensional magnetic systems and nanostructures.
- To know the main experimental technologies (skills) to characterize electronic, magnetic properties and of transport of nanoestructuras. To be able to use experimental tools for measuring magnetic and transport properties of magnetic nanostructures.
- To know and to understand the most relevant magnetic, electronic and transport properties in magnetic materials at the nanoscale and in nanostructures.
- To know the multiple applications of the magnetic nanostructures as well as the future trends of research within the Nanomagnetism area.

DESCRIPTION OF CONTENTS

1. Molecular nanomagnetism and spintronics.

1. Nanomagnetism basic concepts. Artificial interphases influence, proximity and dimensionality effects. Magnetic textures (magnetic domain, magnetic vortices, skirmions)
2. Magnetic properties and scales. Magnetic inversion process, size effects and dynamic processes. Spintronics (spin valves, MTJ, spin torque effect), orbitronics (Spin Hall effect, Inverse SHE).
3. Characterization experimental techniques of electronic, magnetic and transport properties of nanostructures.
4. Fundamental theoretical models for magnetism and nanoscopic scale related phenomena study.
5. Recent developments and future recent tendencies in Molecular Nanomagnetism (magnetic molecules, single-molecule magnets,).
6. Spintronics based on molecular materials (organic spintronics): Molecular spin-valves fabrication and interphase engineering. Multifunctional devices fabrication.
7. Molecular Nanospintronics (single-molecule devices: quantum computing with magnetic qubits based on molecules).

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	22.50	100
Seminars	7.50	100
Tutorials	6.00	100
Other activities	2.00	100
Preparation of evaluation activities	56.50	0
Preparing lectures	18.00	0
TOTAL	**112.50**	

TEACHING METHODOLOGY

- Theory classes, participatory lectures
- Articles discussion.
- Chaired debate or discussion.
- Practical cases or seminar problems discussion.
- Seminars.
- Problems.
- Laboratory practices and demonstracions and visit to installations.
- Experts conferences.
- Attendance to courses, conferences and round tables.

EVALUATION

Written exam about the subject basic contents	70-90%
Attendance and active participation in seminars.	0-10%
Questions answering	10-20%

REFERENCES

Basic

- Micromachines & Nanotechnology: The Amazing New World of the Ultrasmall, David Darling, Silver Burdett Press, 1995.
-World Scientific Series in Nanoscience and Nanotechnology: Volume 3. Molecular Cluster Magnets Edited by: Richard Winpenny (The University of Manchester, UK) World Scientific, 2012.
- J. Stöhr and H.C. Siegmann, Magnetism: From Fundamentals to Nanoscale Dynamics, Springer Series in solid-state sciences, Springer Berlin Heidelberg New York (2006). ISBN-13 978-3-540-30282-7
- World Scientific Series in Nanoscience & Nanotechnology: Vol. 3. Molecular Cluster Magnets Edited by: R. Winpenny (University of Manchester, UK) World Scientific, 2012. ISBN: 978-981-4464-02-4.

- Focus: Organic Spintronics, Nature Materials 8, No. 9 (September 2009).
- Molecular vs inorganic spintronics: role of molecular materials and single molecules, Julio Camarero & Eugenio Coronado, J. Mater. Chem. Highlight 19, 1678 (2009).