

**COURSE DATA****Data Subject**

<b>Code</b>	44422
<b>Name</b>	Molecular nanomaterials: Methods of preparation, properties and applications
<b>Cycle</b>	Master's degree
<b>ECTS Credits</b>	6.0
<b>Academic year</b>	2022 - 2023

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
2208 - M.D. in Molecular Nanoscience and Nanotechnology	Faculty of Chemistry	1	First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
2208 - M.D. in Molecular Nanoscience and Nanotechnology	6 - Molecular nanomaterials: Methods of preparation, properties and applications	Obligatory

**Coordination**

<b>Name</b>	<b>Department</b>
CORONADO MIRALLES, EUGENIO	320 - Inorganic Chemistry

**SUMMARY**

We intend to provide the students with the necessary knowledge on the basic aspects of Nanoscience alongside with its implications in the design and development of new molecular materials with unconventional properties.

**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.D. in Molecular Nanoscience and Nanotechnology**

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- 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 know the methodological approaches used in Nanoscience.
- To acquire supramolecular chemistry conceptual concepts necessary for the design of new nanomaterials and nanostructures.
- To know the state of the art in molecular nanomaterials with optical, electric and magnetic properties.
- To assess the relationships and differences between the materials macroscopic properties and those of unimolecular systems and nanomaterials.
- 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**



We intend to provide the students with the necessary knowledge on the basic aspects of Nanoscience alongside with its implications in the design and development of new molecular materials with unconventional properties.

## DESCRIPTION OF CONTENTS

### 1.

#### **Molecular Nanomaterials: Preparation methods, properties and applications.**

1. Molecular Magnetic Materials: Design, synthesis, characterization and applications of i) molecular nanomagnets; ii) magnetic nanoparticles obtained by a molecular approach; iii) switchable magnetic molecules iv) multifunctional molecular magnetic multilayers and magnetic materials.
2. Materials with optical properties: Liquid crystals, materials for nonlinear optics, optical limiters, etc.; supramolecular types of organizations and applications.
3. Materials with electrical properties: molecular conductors and superconductors: electronic structures, organization on surfaces and interfaces, properties and applications (chemical sensors, field effect transistors (FETs), etc.).
4. Conducting polymers: Properties and applications.
5. Carbon nanoforms: Structures, properties, methods of production and organization and applications.
6. 2D crystals.
7. Applications of nanomaterials in biomedicine (contrast agents, drug delivery, teragnostic systems)

## WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Seminars	9,00	100
Tutorials	8,00	100
Other activities	2,00	100
Preparation of evaluation activities	80,00	0
Preparing lectures	21,00	0
<b>TOTAL</b>	<b>150,00</b>	

## 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

- G.A. Ozin, A.C. Arsenault: Nanochemistry. The Royal Society of Chemistry, 2005.
- H.S. Nalwa Ed.: Handbook of Advanced Electronic and Photonic Materials and Devices, Academic Press, 2001.
- D.M. Guldi, N. Martín Eds.: Fullerenes: From Synthesis to Optoelectronic Properties. Kluwer Academic Press, Dordrecht, Netherland, 2002.
- P.J. Collings, Liquid Crystals: Nature's delicate order of Matter. 2<sup>a</sup> Ed., Princeton University Press, 2002.
- M.C. Petty, M.R. Bryce, D. Bloor, Eds.: Introduction to Molecular Electronics, Oxford University Press, NY, 1995.
- Ulman, An Introduction to Ultrathin Organic Films: from Langmuir-Blodgett to Self-Assembly, Academic Press, San Diego, 1991
- Supramolecular Chemistry: From Molecules to Nanomaterials, ed. P. Gale and J. Steed, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2012
- Nanomedicine, in Nanotechnology, ed. H. Fuchs, M. Grätzel, H. Krug, G.
- Schmid, V. Vogel and R. Waser, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2010, vol. 5