Teaching guide

Subject identification

Subject	11283 - Functional Materials
Credits	0.72 de presencials (18 hours) 2.28 de no presencials (57 hours) 3 de totals (75 hours).
Group	Group 1, 1S (Campus Extens)
Teaching period	First semester
Teaching language	English

Professors

Lecturers	**Horari d'atenció als alumnes**					
	Starting time	**Finishing time**	**Day**	**Start date**	**Finish date**	**Office**
Rubén Santamarta Martínez ruben.santamarta@uib.es	15:00	16:00	Tuesday	12/09/2016	24/07/2017	F114 - 1r pis, Mateu Orfila (imprescindible cita prèvia)
	12:00	13:00	Tuesday	12/09/2016	24/07/2017	F114 - 1r pis, Mateu Orfila (imprescindible cita prèvia)
Joan Torrens Serra j.torrens@uib.es	15:00	17:00	Monday	15/09/2016	01/02/2017	F135
	15:00	16:00	Monday	01/03/2017	04/06/2017	F135

Contextualisation

A big number of materials can change one (or more) properties in a controlled way by means of external applied fields, which make them very attractive for both applications as well as for the scientific point of view. There are a huge number of these types of materials and a lot of time can be devoted to each of them. In this subject only some examples of the most common functional (or smart) materials will be introduced, as conventional and magnetic shape memory alloys, piezoelectric materials and magnetostrictive materials.

The academic and research background of the lecturers fit perfectly with the topic of the subject. Rubén Santamarta has a degree in Physics by the UIB and a PhD in Physics by the same university (2002, with honors). He is an Associate Professor at the area of Applied Physics,hehas teaching experience since 2001 and two master's degrees in teaching. Hebelongs to the Material Physicsresearch group in which his main line of research is shape memory alloys, field in which he has published more than 40 articles in indexedinternational journals,collaborated on more than 50 papers in international conferences and participated in more than 10 national and international projects. Between 2002 and 2004 he held a post-doctoral stay at the EMAT (Antwerp, Belgium) to improve his skills in transmission electron microscopy (TEM). Joan Torrens has a degree in Physics and also in Materials engineering and is Doctor in Materials Science (Physics) from the UAB. Currently is assistant professor in the area of Applied Physics and researcher in Materials Physics Group of the UIB. He has spent 2 years at IFW Dresden working in the field of Metallic Glasses. He has published about 20 papers in international indexed journals.

Date of publication: 17/11/2016

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Requirements

We can divide the requirements in two groups: the essential, or mandatory, requirements and the recommendable ones:

Essential requirements

Those stablished by the general regulation of the Master in Advanced Physics and Applied Mathematics (FAMA in Spanish).

Recommendable

It is recommended to have some background in materials science.

Skills

The following skills are supposed to be trained, or achieved, during the course (the codes of the competences are the ones used in the official Master Program).

Specific

* CE3: To acquire advanced knowledge on the frontier of knowledge and demonstrate, in the context of internationally recognized scientific research, a full understanding of theoretical and practical aspects of the scientific methodology.
* EFM5: To acquire the knowledge of various types of functional materials and the mechanisms related to its functionality.

Generic

* CG1: Systematic understanding of a field of study and mastery of the skills and the methods associated with the research in that field.
* CB6: Possess the knowledge and its understanding to provide the basis or opportunity to be original in developing and/or applying ideas, often within a research context...
* CB7: Students can apply the broader (or multidisciplinary) acquired knowledge and ability to solve problems in new or unfamiliar environments within contexts related to their field of study.
* CB10: Students gain the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.

Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

Content

Theme content

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1. Introduction to functional materials

2. Conventional shape memory alloys
   - Introduction to the martensitic transformation
   - Crystallography of the martensitic transformation
   - Common effects and properties of shape memory alloys
   - NiTi based alloys, Cu-based alloys and other systems showing shape memory properties.
   - Characterization of shape memory alloys
   - Applications

3. Magnetic shape memory alloys
   - Ferromagnetic shape memory alloys
   - Metamagnetic shape memory alloys
   - Coupling of the magnetic and structural transition
   - Alloys with magnetic shape memory properties

4. Magnetocaloric and multiferroic materials
   - Magnetocaloric effect
   - Multiferroic materials

5. Magnetrostrictive materials
   - Classical magnetostriction
   - Magnetostrictive materials

6. Piezoelectric and ferroelectric materials
   - Piezoelectricity
   - Ferroelectricity
   - Applications of piezo- and ferroelectric materials

7. Other functional materials

Teaching methodology

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Theory classes	Large group (G)	The theoretical basis of the content will be introduced by the lecturers by means of master classes.	14
Seminars and workshops	Seminars	Medium group 2 (X)	The student will be asked to attend to one or two seminars about recent research on functional materials.	1
Laboratory classes	Laboratory classes	Small group (P)	Some laboratory activities will be carried out in the research laboratory of the Materials Physics research group under the supervision of a lecturer.	1
Assessment	Oral communication	Small group (P)	The students should make a presentation of the final report in a scientific style.	1
Assessment	Theoretical examination	Large group (G)	The student will be partially avaluated by means of a written assessment consisting on theoretical short questions about	1

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Modality	Name	Typ. Grp.	Description	Hours
			functional materials. This assessment will take place before March 13th.	

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Campus Extens platform.

Distance education work activities

Modality	Name	Description	Hours
Individual self-study	Report	The students must write a report on a subject that will be proposed by the lecturers of the subject.	30
Individual self-study	Study for the assessment	The student should study the contents of the course in order to pass an examination with short theoretical questions.	27

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

If the final mark, considering the average weight of each activity, is equal to or greater than 5 but the student has not obtained the minimum score required in all the elements of assessment, a overall grade of 4.5 will be applied.

Oral communication

Modality	Assessment
Technique	Oral tests **(retrievable)**
Description	The students should make a presentation of the final report in a scientific style.
Assessment criteria	

Final grade percentage: 20%

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Theoretical examination

Modality	Assessment
Technique	Extended-response, discursive examinations **(retrievable)**
Description	The student will be partially avaluated by means of a written assessment consisting on theoretical short questions about functional materials. This assessment will take place before March 13th.

Assessment criteria

Final grade percentage: 30%

Report

Modality	Individual self-study
Technique	Papers and projects **(retrievable)**
Description	The students must write a report on a subject that will be proposed by the lecturers of the subject.

Assessment criteria

Final grade percentage: 50%

Resources, bibliography and additional documentation

Basic bibliography

· Shape memory materials/ edited by K. Otsuka and C.M. Wayman.Cambridge : Cambridge University Press, 1998.

· Functional materials: preparation, processing and applications / [edited by] S. Banerjee, A.K. Tyagi.Amsterdam : Elsevier, 2012

Other resources

· Papers from scientific journals related with functional materials (hard or digital copies will be provided to the students)

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