

Academic year	2017-18
Subject	11291 - Spintronics
Group	Group 1, 2S
Syllabus	A
Language	English

Subject

Name	11291 - Spintronics
Credits	0.72 in-class (18 hours) 2.28 distance (57 hours) 3 total (75 hours).
Group	Group 1, 2S (Campus Extens)
Period	Second semester
Language	English

Lecturers

Lecturers	Office hours for students					
	Starting time	Finishing time	Day	Start date	End date	Office
Maria Rosa López Gonzalo rosa.lopez-gonzalo@uib.es	09:00	10:00	Monday	15/09/2017	31/07/2018	208
David Sánchez Martín david.sanchez@uib.es	14:00	15:00	Monday	24/10/2017	31/01/2018	Despatx 205 (IFISC)
Llorenç Serra Crespi llorens.serra@uib.es	14:30	15:30	Monday	01/09/2017	31/07/2018	209, Edifici dels Instituts Universitaris

Context

Spintronics is an emerging field of physics which exploits the properties of the spin degree of freedom. Exciting discoveries in recent years include giant magnetoresistance, spin torques and spin Hall effect. From a more practical point of view, spintronic devices will have a significant impact in future electronics due to their lower power consumption and their novel functionalities.

Requirements

Recommended

Quantum mechanics. Solid state physics.

Skills

Specific

- * ESQ7 - Understanding of the magnetic properties of solids and their applications for nanoelectronic devices..

Syllabus

- * CE1 - Students must possess the learning skills that enable them to combine specialized knowledge in Astrophysics and Relativity, Geophysical Fluids, Materials Physics, Quantum Systems or Applied Mathematics, with the versatility that provides an open training curriculum...
- * CE2 - Students must possess the ability to use and adapt mathematical models to describe physical phenomena of different nature.
- * CE3 - To acquire edge-line knowledge in the international scientific research context and demonstrate a full comprehension of theoretical and practical aspects, together with the scientific methodology..

Generic

- * CG1 - Sistematic comprehension of a field of knowledge and its related skills and research methods.
- * 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

1. Introduction
Magnetism in solids. Zeeman effect. Magnetic interactions: exchange and superexchange. Ferromagnetism. Stoner model. Magnetic semiconductors. Spin-orbit interaction in semiconductors: Rashba and Dresselhaus.
2. Spin decoherence
Spin relaxation. Bloch equations. Times T1 and T2. Elliot-Yafet and Dyakonov-Perel mechanisms. Hyperfine interaction.
3. Nanoscale spintronics
Giant magnetoresistance. Tunnel magnetoresistance. Spin-torque transfer. Spin field-effect transistor. Ferromagnetic-semiconductor interfaces. Spin Hall effect.
4. Spin quantum computation
Qubits. Quantum dots.

Teaching methodology

In-class work activities

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Modality	Name	Typ. Grp.	Description	Hours
Theory classes		Large group (G)	Lectures.	18

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	Presentation.	Present and discuss a relevant paper in the field of spintronics.	37
Individual self-study	Problems.	Solve the proposed list of problems.	20

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

Presentation.

Modality	Individual self-study
Technique	Papers and projects (non-retrievable)
Description	Present and discuss a relevant paper in the field of spintronics.
Assessment criteria	
Final grade percentage:	50%



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Problems.

Modality	Individual self-study
Technique	Papers and projects (retrievable)
Description	Solve the proposed list of problems.
Assessment criteria	
Final grade percentage:	50%

Resources, bibliography and additional documentation

Basic bibliography

Fabian, Jaroslav, et al. "Semiconductor spintronics." Acta Physica Slovaca. Reviews and Tutorials 57.4-5 (2007): 565-907.
Wolf, S. A., et al. "Spintronics: a spin-based electronics vision for the future." Science 294.5546 (2001): 1488-1495.

