Universidad Zaragoza

Academic Year/course: 2023/24

26930 - Solid State II

Syllabus Information

Academic year: 2023/24
Subject: 26930 - Solid State II
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 6.0
Year: 4
Semester: Second semester
Subject type: Compulsory
Module:

1. General information

This subject provides the student with knowledge of the theories that describe different cooperative phenomena in solid, such as magnetism and superconductivity. It introduces the student to the current theories on real solid and nanostructured materials. This subject is part of the Structure of Matter module of degree in Physics and constitutes, together with Solid State Physics I, the subgroup of subjects of contents related to the phenomenology and formalism of condensed matter physics. Therefore, it will provide the minimum base necessary to be able to continue with more specialized subjects in related Masters, such as Condensed Matter Physics and Nanostructured Materials and their Applications.

2. Learning results

- To know the problems and limitations encountered by classical physics and the need to introduce a description at the microscopic level.
- To understand the physical meaning of relevant properties of condensed matter, such as transport and magnetic phenomena.
- To address real applications that students may encounter in their subsequent professional activity. To relate basic concepts and interpret the relevance of quantum physics to explain physical phenomena.
- To be able to address specific problems in science and technology of materials of industrial interest due to their electrical, magnetic or superconducting properties.
- To know the phenomenology and theories of magnetism of the atom and solids from a microscopic point of view.
- To know the phenomena related to superconductivity and the semiphenomenological and quantum-mechanical theories governing this phenomenon.
- To know the relevance of surface effects in relation to the magnetic, dielectric and superconducting properties of nanostructured materials.
- Dielectric phenomena based on the microscopic structure of matter.
- The Solid State Physics II subject is a fundamental element for the consolidation of their learning of the concepts and tools provided by quantum mechanics. It prepares students for their professional career in the field of research or other professional fields of new materials or theories related to them.

3. Syllabus

- Topic I: Dielectrics and ferroelectrics: macroscopic description. Microscopic theory: polarizability. Ferroelectricity Theory of phase transitions.
- Topic II: Diamagnetism and paramagnetism: localized and free electrons. Classical and quantum theories.
- Topic III: Ferromagnetism: long-range order. Exchange interaction. Mean field theory. Magnetism of metals and insulators. Antiferro and ferrimagnetism. Magnetic domains.
- Topic IV: Superconductivity: Meissner effect. Superconducting gap. Classical and quantum theory. Vortex networks. Andreev Reflection.
- Topic V: Nanostructures: observation techniques. Nanoparticles. Thin films.

4. Academic activities

- Lectures: they present to the student the basic theoretical contents to achieve the acquisition of the associated

technical competences (CE1, CE2, CE3, CE4, CE5, CE6, CE10)

- Problem solving: allows the acquisition of technical competences from a practical point of view (CE1, CE2, CE3, CE5, CE6, CE10)
- Oral presentations by students. Each student will give at least a 10-minute summary at the beginning of the class, dealing with the content of the previous day's class. This task will be assigned to a student each day.
- Completion of reports of seminars to broaden knowledge scheduled within the framework of the subject (usually two per term)
- Practical laboratory demonstrations: allow the acquisition of knowledge of some relevant techniques in the characterization of solids (CE7, CE8, CE9)

5. Assessment system

Passing the continuous evaluation activities

a) Completion of problems and questions on each of the topics of the subject throughout the teaching period Oral presentation of these papers by designation of the teacher. Attendance and writing of a summary of the seminars given within the framework of the subject. The average grade for this activity will account for 20% of the final grade. The teacher will assign them individually based on the work developed throughout the term.

b) Carrying out practical laboratory demonstrations throughout the teaching period. Students must submit a written report of the laboratory sessions conducted. The grade of these reports constitutes 10% of the final grade.

c) Result of the examination test, which shall constitute 70% of the overall result. The exam will consist of two parts, one of theoretical questions, and another of problems. The result of the exam will be 75% of the grade of the theoretical part and 25% of the exercises.

The student will be able to obtain 100% of the final grade of the subject through activities a, b, c.

Passing the subject by means of a single global test

The evaluation will be obtained directly from a written examination test.