60042 - Quantum theory of condensed matter

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	538 - Master's in Physics and Physical Technologies
ECTS	5.0
Year	1
Semester	First semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

The course in "Quantum Theory of Condensed Matter Physics" can be recommended to any student interested in the behavior of matter, especially when it is made of strongly interacting particles. The course addresses the physics of electrons in metals, superconductivity, superfluidity, low-dimensional systems (such as graphene and carbon nanotubes), and other strongly correlated systems. The goal is to familiarize the student with theoretical concepts and tools that can be used both to analyse some known properties of matter and to explore new properties. At the end of the course, the student should be able to use and apply some of these techniques to real scientific problems.

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

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5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, autonomous work, study, problem-solving exercises, and seminars by renowned researchers in the field.

5.2.Learning tasks

The course includes the following learning tasks:

1. Lectures on the main topics of the course (3 ECTS).
2. Problem-solving sessions (1 ECTS).
3. Knowledge and use of computational tools in the field of the course (1 ECTS).
4. One-hour seminars run by renowned researchers in the field.

5.3.Syllabus

The course will address the following topics:

1. Introduction: Problems in the treatment of many-body physics. From particles to fields. Quasiparticles.
2. The second quantification. Fock space.
3. Systems of interacting fermions: metals. Fermi gas, Fermi liquid, screening and the random phase approach. Wigner crystal.
4. Theory and applications of functional density (DFT).
5. Boson systems. Bose-Einstein condensation: ideal gas of bosons and weak interacting bosons. Microscopic theory of superconductivity and superfluidity.
6. Low-dimensional systems. Graphene. One-dimensional interacting systems: Luttinger liquid.
7. The theory of linear response: correlation functions.

5.4.Course planning and calendar

Further information concerning the timetable, classroom, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the Faculty of Science http://ciencias.unizar.es/

5.5.Bibliography and recommended resources