Physics of condensed matter - course description

General information

Course name	Physics of condensed matter
Course ID	13.2-WF-FizD-SS- 19
Faculty	Faculty of Physics and Astronomy
Field of study	WFiA - oferta ERASMUS
Education profile	-
Level of studies	Erasmus programme
Beginning semester	winter term 2023/2024

Course information

Semester	1
ECTS credits to win	7
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. Mirosław Dudek

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Class	30	2	-	-	Credit with grade
Lecture	30	2	-	-	Exam

Aim of the course

The aim of the course is to provide students with basic knowledge of condensed matter physics and the corresponding research methods with the learning outcomes in the area of science. Students should know the basics of crystallography, the concept of reciprocal lattice, diffraction methods for determining the crystal structure, they should be familiar with the issue of an electron in a periodic potential, the question of the formation of the band structure in solids, examples of band structures of selected metals, the harmonic crystal approximation, they should know in detail the selected problems of condensed phase in the quantum description, including superconductivity.

Prerequisites

It is assumed that students know subjects of general physics and they have got basic course of mathematical analysis (knowledge and skills that meet the criteria K2A_W01).

Scope

- Crystal lattices, the classification of Bravais lattices and crystal structures.

- Reciprocal lattice, diffraction methods to determine the crystal structure (Laue condition, Bragg equation, Brillouin zones, geometric structural factor).

- An electron in a periodic potential, the Bloch theorem, Kronig-Penney Model.

- Band theory of solids: metals, semiconductors and dielectrics, examples of band structures.

- Crystal in the harmonic approximation (classical and quantum theory), dispersion relations, normal modes in 1D monatomic Bravais lattices, one-dimensional chain with basis, acoustic and optical branches at Brillouin zone boundary.

- Selected issues: continuum linear elastic theory, wave propagation, specific heat, Debye model.

- Superconductivity.

Teaching methods

Teaching methods have two forms: lecture and exercises.
During the lecture both theory and selected examples are presented. Next, the examples are recommended to be extended at exercises. Students increase their computational skills by solving these examples in detail. In addition, they discuss selected problems.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Students can explain and describe particular phenomena.		• a discussion • a quiz • an exam - oral, descriptive, test and other	• Lecture • Class

Outcome description	Outcome symbols	Methods of verification	The class form
Students have a basic knowledge of the methods of condensed matter physics. General knowledge is supported by a detailed skills in computing for selected models such as one-dimensional model Kröning-Penney'go one-dimensional chain of atoms - unions dispersion, specific heat, which allow broader understanding of the more general theoretical frameworks.		• a discussion • a quiz • an exam - oral, descriptive, test and other	• Lecture • Class

Assignment conditions

The course ends with an exam grade. Examination is a written test of theoretical knowledge and practical skills in accounting. The effects of exercise training are reviewed by partial reviews on completed tasks, evaluation of written tests and assessment of accounting skills and understanding of selected topics of condensed matter physics.

Overall rating: arithmetic mean score of the exam and exercises.

Recommended reading

[1] Neil W. Ashcroft, N. David Mermin, *Solid State Physics*, Harcourt College Publishers 1976

[2] C. Kittel, *Introduction to solid state physics*, John Wiley& Sons Inc, 1996.

[3] L. E. Reichl, *A Modern Course in Statistical Physics*, E. Arnold (Publishers) LTD, University of Texas Press 1980.

Further reading

[1] Donald A. MCQuarrie, *The Kroning-Penney Model: A Single Lecture Illustrating the Band Structure of Solids*, in The Chemical Educator VOL. 1. 1996 Springer-Vellag New York, inc.

[2] F. Reif, *Fundamentals of Statistical and Thermal Physics*, Mc Graw-Hill, Singapore 1985

Notes

Modified by dr Marcin Kośmider (last modification: 06-02-2023 22:49)