GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Solid-state Physics and Semiconductors I (E024610)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 1)	Dutch	Gent	practical
			seminar
			lecture

Lecturers in academic year 2024-2025

Vrielinck, Henk	WE04	lecturer-in-charge
Khelifi, Samira	WE04	co-lecturer

Offered in the following programmes in 2024-2025	crdts	offering
Bachelor of Science in Engineering(main subject Engineering Physics)	6	A
Bridging Programme Master of Science in Engineering Physics	6	A
Master of Science in Electromechanical Engineering(main subject Control Engineering and Automation)	6	A
Master of Science in Electromechanical Engineering(main subject Electrical Power Engineering)	6	A
Master of Science in Electromechanical Engineering(main subject Maritime Engineering)	6	A
Master of Science in Electromechanical Engineering(main subject Mechanical Construction)	6	A
Master of Science in Electromechanical Engineering(main subject Mechanical Energy Engineering)	6	A

Teaching languages

Dutch

Keywords

Crystal lattice, phonons, energy bands, mobility, recombination, optical absorption

Position of the course

To provide a profound basic knowledge of solid state physics, including the main elements of crystallography. To provide a good basic knowledge of the electrical and optical properties of semiconductors.

Contents

- Crystal structure and bonds: Crystal structure, The reciprocal lattice, Bonding in crystals
- Phonons: Lattice vibrations, Thermal properties of solids
- Free-electron theory of metals: Free electron gas, Heat capacity of electron gas, Electrical conduction, Thermal conduction
- Band theory: Energy bands, Energy bands in semiconductors
- Electrical properties of semiconductors: Equilibrium charge carrier concentration, Electrical conduction, Carrier recombination and diffusion
- Optical properties of solids: Infrared spectrum of phonons, Optical effects of free carriers, Interband absorption in semiconductors, Exciton absorption, Luminescence

Initial competences

Quantum Mechanics I, Physics III

Final competences

1 Understand the basic theoretical concepts of solid state and semiconductor

physics (direct and reciprocal lattice, phonons, electronic band structure, Fermi level, effective mass, holes) and being able to apply these concepts to materials with a highly symmetric crystal structure.
2 Being able to derive, schematize, and explain the relation between the internal structure of a solid and its macroscopic (elastic, thermal, electric and optical) properties.
3 Recognize doping as a method to control the electronic properties of semiconductors.
4 Have the practical skill to determine the crystal structure of a solid (with a highly symmetric lattice) from its X-ray diffraction pattern.
5 Have the practical skill to derive information on the band structure of a semiconductor from its optical absorption spectrum.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Practical

Extra information on the teaching methods

Two lab exercises in groups in the course of the semester

Study material

Type: Syllabus

Name: Solid state physics and semiconductors I - syllabus
Indicative price: € 8
Optional: no
Language : Dutch
Number of Pages : 249
Oldest Usable Edition : edition 2023-2024
Available on Ufora : Yes
Online Available : No
Available in the Library : No
Available through Student Association : Yes
Additional information: A printed version of the course can be used on the exercise exam. The syllabus is available through VTK and on UFORA, so students can also print it themselves. All other course material (exercises, slides) is available on UFORA, cannot be used on the exam, so does not need to be printed.

References

- C. Kittel, "Introduction to Solid State Physics", 7th edition, J. Wiley, New York 1996

Course content-related study coaching

Interactive guidance via the electronic learning platform; personal contact with teacher(s).

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment, Written assessment with open-ended questions, Written assessment open-book

Examination methods in case of periodic assessment during the second examination period

Oral assessment, Written assessment with open-ended questions, Written assessment open-book

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

- During examination period:
  - Theory : written closed-book exam complemented with oral examination
  - Exercises : written open-book exam - problems.

- During semester: evaluation of the lab reports (2 group reports) ; non-participation in the lab exercises leads to zero for this part of the final evaluation

Calculation of the examination mark

Theory : 50 %
Exercises - problems : 35 %
Lab reports : 15 %
Marks of the lab reports are transferred to the second exam period.