GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Solid State and Nano Physics (C004503)

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

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2026-2027

A (semester 1)	English	Gent

Lecturers in academic year 2026-2027

Detavernier, Christophe	WE04	lecturer-in-charge
Vrielinck, Henk	WE04	co-lecturer

Offered in the following programmes in 2026-2027	**crdts**	**offering**
Master of Science in Teaching in Science and Technology(main subject Physics and Astronomy)	6	A
Master of Science in Physics and Astronomy	6	A
Master of Science in Physics and Astronomy	6	A
Exchange Programme in Physics and Astronomy (Master's Level)	6	A

Teaching languages

English

Keywords

Solid state physics, optics, transport, nano physics

Position of the course

The content from the bachelor course on basic solid state physics is extented to solid state nano structures. A second objective of this course is to make students familiar with present-day research in this domain.

Contents

Theory of bulk semiconductors :
· Band structure
· Band-to-band transitions, optical absorption
· Effective mass theory, excitons, donors and acceptors
· Luminescence
· Classical transport (drift and diffusion)
· Depletion layers
· Applications
Solid state nano structures
· Energy levels and density of states in 0-2 dimensions
· Optical properties
· 2D systems : quantum wells, heterostructures
· 1D systems : nanowires, carbon nanotubes
· 0D systems : quantum dots
· Landauer formalism for conduction - ballistic transport
· Tunneling, Coulomb blockade
· Quantization of electrical conductance - quantum point contacts
Seminars
Current topics in solid state science : synthesis and characterization techniques, applications

Initial competences

Succeeded in the following bachelor courses (or their equivalent) :
"Vastestoffysica", "Kwantummechanica" and "Atoom- en molecuulfysica".

Final competences

1 Using the band model to explain the operation of electronic and opto-electronic devices.
2 Calculating transition probabilities for optical transitions.
3 Calculating transport properties of low dimensional structures.
4 Understanding the influence of low dimensionality on the band structure of materials.
5 Knowledge of and critical attitude against current research topics in solid state physics.

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

Lecture

Extra information on the teaching methods

Learning material: Lecture notes: € 10

Study material

Type: Syllabus

Name: Solid-state and Nanophysics
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Pages : 300
Available on Ufora : Yes
Online Available : No
Available in the Library : No
Available through Student Association : No

References

M. Fox, "Optical properties of solids", Oxford University Press, 2001
P. K. Basu, "Theory of optical processes in semiconductors", Oxford University Press, 1997
David Ferry, "Transport in Nanostructures", Cambridge University Press, 2000
T. Heinzel, "Mesoscopic electronics in Solid State Nanostructures", Wiley-VCH, 2007

Course content-related study coaching

E-learning on Ufora, possibility for contacting the lecturers by appointment.

Assessment moments

end-of-term assessment

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

Oral assessment

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

Oral assessment

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Oral exam with written preparation

Calculation of the examination mark

100% periodic evaluation