UNIVERSITEIT GENT

Studiefiche

Vanaf academiejaar 2024-2025

Materials Physics (C004141)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 6.0 **Studietijd 180 u**

Aanbodsessies en werkvormen in academiejaar 2025-2026

A (semester 1)	Engels	Gent	hoorcollege
			werkcollege

Lesgevers in academiejaar 2025-2026

Hens, Zeger	WE06	Verantwoordelijk lesgever
Cottenier, Stefaan	TW08	Medelesgever

Aangeboden in onderstaande opleidingen in 2025-2026	**stptn**	**aanbodsessie**
Educatieve Master of Science in de wetenschappen en technologie(afstudeerrichting chemie)	6	A
Master of Science in Chemistry(afstudeerrichting Materials and Nano Chemistry)	6	A
Master of Science in Chemical Engineering	6	A
Master of Science in de ingenieurswetenschappen: chemische technologie	6	A
Uitwisselingsprogramma chemie (niveau master)	6	A

Onderwijstalen

Engels

Trefwoorden

Situering

The course teaches students materials physics, using a dual track where the main concepts are introduced through analytical model systems and detailed by a computational approach. The course covers a typical selection of topics in solid-state physics, including a description of crystal lattices and an introduction to reciprocal space through the problem of diffraction. Next, crystal binding is addressed, together with the mechanical and thermal properties of crystals. Electronic states in solids are addressed from the free electron gas to band-theory. Optical properties of metals and semiconductors are discussed and so are the main solid-state devices, including photovoltaic cells, photodiodes and light emitting diodes. The modules (1) concepts in materials physics and (2) computational materials physics can be followed as Advanced Topics in Chemistry.

Inhoud

Conceptual material physics

1 Crystal structures – point groups and space groups, main crystal structures.
2 Diffraction from crystals – introducing reciprocal space.
3 Crystal binding and elasticity – stress and strain.
4 Phonons – lattice vibrations and the heat capacity of solids.
5 Quantum statistics – the distribution of bosons and fermions over energy levels.
6 Electronic states in solids – from the free electron gas to energy bands.
7 Semiconductors – electrons, holes and the effective mass model.
8 Otical properties of solids – metal versus semiconductors
9 Semiconductor devices – using the *p-n* junction for converting, detecting and emitting light.

Computational material physics

Using a general purpose density functional theory code to:

1 Calculate total energies of crystals

2 Calculate crystal geometries
3 Calculate energy band structures
4 Calculate elastic crystal properties
5 Calculate phonon dispersion relations

Begincompetenties

Students have a background in mathematics for chemists, basic physics and materials chemistry.

Eindcompetenties

1 Students understand the symmetry properties of crystals and can implement crystal structures in a computational tool.
2 Students can use reciprocal space to describe diffraction from crystals and can calculate the reciprocal lattice of a given real space lattice
3 Students know qualitative approaches to describe crystal binding and can use computational methods to evaluate the stability of crystals.
4 Students can describe lattice vibrations as wave phenomena, can extend this picture to obtain quantized oscillators or phonons and compute the phonon dispersion relation of a given material.
5 Students have insight in quantum statistics and use quantum statistics to describe the distribution of phonons or electrons over the available energy levels.
6 Students have insight in the band theory of solids and can calculate the band structure of a given material.
7 Students are familiar with approximative methods to describe the electronic properties of semiconductors and know how these methods are related to the semiconductor band structure.
8 Students can describe the optical properties of metals and semiconductors in terms of their electronic structure.
9 Students can explain the properties of a *p-n* junction and the use of this device for conversion, detection and emission of light.

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Werkcollege, Hoorcollege

Toelichtingen bij de didactische werkvormen

Hoorcolleges, werkcolleges, flipped classroom.

Studiemateriaal

Type: Syllabus

Naam: Cursus tekst'
Richtprijs: Gratis of betaald door opleiding
Optioneel: nee

Referenties

- Introduction to Solid State Physics, Charles Kittel

Vakinhoudelijke studiebegeleiding

Evaluatiemomenten

periodegebonden en niet-periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Evaluatievormen bij niet-periodegebonden evaluatie

Tweede examenkans in geval van niet-periodegebonden evaluatie

Niet van toepassing

Toelichtingen bij de evaluatievormen

Periodegebonden en niet-periodegebonden valuatie

Eindscoreberekening

- Niet-periodegebonden 2/20
- Periodegebonden theorie-examen 10/20
- Periodegebonden oefeningexamen 8/20