GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2017-2018

Physics and Chemistry of Nanostructures (C003120)

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

Credits 6.0	Study time 180 h	Contact hrs	52.5 h

Course offerings and teaching methods in academic year 2018-2019

A (semester 1)	English	seminar: coached exercises	22.5 h
		lecture	30.0 h

Lecturers in academic year 2018-2019

Hens, Zeger	WE06	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Master of Science in Physics and Astronomy	6	A
Master of Science in Biomedical Engineering	6	A
International Master of Science in Biomedical Engineering	6	A
Master of Science in Biomedical Engineering	6	A
European Master of Science in Photonics	6	A
Exchange Programme in Physics and Astronomy (Master's Level)	6	A

Teaching languages

English

Keywords

Nanoscience and technology, colloidal nanocrystals, self-assembly, quantum confinement, quantum transport

Position of the course

Physics and Chemistry of nanostructures is an optional course of the master in physics program,, dealing with nanoscience and technology. It addresses physical phemonena at the nanoscale, the synthesis of nanoscale objects and techniques for measurement and manipulation at the nanoscale. The goal of the course is to make students understand (1) the driving force behind miniaturization, (2) how to make nanoscale objects, (3) the dependence of materials properties on size and (4) the operation of nanoscale devices. The course relies strongly on recent literature. During the course, students will learn how to read, understand and use scientific literature.

Contents

1. Introduction: nanoscience and technology: what, why and how - observation, measurement and manipulation at the nanoscale.
2. Concepts of bottom-up nanotechnology: syntheses of colloidal nanocrystals - self-assembly as a construction principle.
3. Physical properties of nanoscale materials: electronic energy levels in nanostructures - quantum confinement - optical properties of quantum dots.
4. Quantum transport: tunneling - single-electron tunneling and Coulomb-blockade - tunneling spectroscopy - electron counting - the quantization of conductance.
5. Nanoscale devices: the single-electron transistor.

Initial competences

Chemie.
Vaste-stoffysica.
Atomic and Molecular Physics

Final competences

1 Students can explain the rationale of nanoscience and technology and discuss the

main trends in bottom-up nanotechnology.
2 Students understand colloidal nanocrystals in terms of synthesis, stability and processing.
3 Students have insight in self-assembly as a bottom-up approach to nanostructures.
4 Students can explain why material properties may depend on particle size.
5 Students can relate quantum confinement to the physical properties of semiconductor nanocrystals.
6 Students understand quantum transport by tunneling.
7 Students can relate Coulomb-blockade to single electron tunneling and understand the functioning of devices based in this effect.
8 Students can discuss about the quantization of conductance.
9 Understand can read, assess and discuss current scientific literature on colloidal nanocrystals.

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, self-reliant study activities, seminar: coached exercises

Learning materials and price

English language course text. A selection of recent papers from literature. Student presentations. Cost: 15 EUR

References

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Course content-related study coaching

Interactive support by means of Minerva. Questions and discussions during and after the classroom lectures. Personal assistance for the preparation of presentations

Evaluation methods

end-of-term evaluation

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

Oral examination, assignment, report

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

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible in modified form

Extra information on the examination methods

To be evaluated, each student has to write and present a review on a recent publication on a topic in nanoscience related to the course. The review is written in a two-step process. Only after a first version has been peer-reviewed by fellow students, a second version is submitted for evaluation. The evaluation is based on the written report, the presentation and the discussion following the presentation.

Calculation of the examination mark

A single mark is given to the whole of review, presentation and discussion.