

## Physics and Chemistry of Nanostructures (C003120)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

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 2020-2021

B (semester 2)	English	Gent	seminar: coached exercises	22.5 h
			lecture	30.0 h

### Lecturers in academic year 2020-2021

Hens, Zeger WE06 lecturer-in-charge

### Offered in the following programmes in 2020-2021

	crdts	offering
<a href="#">Master of Science in Teaching in Science and Technology (main subject Physics and Astronomy)</a>	6	B
<a href="#">Master of Science in Physics and Astronomy</a>	6	B
<a href="#">Master of Science in Biomedical Engineering</a>	6	B
<a href="#">International Master of Science in Biomedical Engineering</a>	6	B
<a href="#">Master of Science in Biomedical Engineering</a>	6	B
<a href="#">European Master of Science in Photonics</a>	6	B
<a href="#">Exchange Programme in Physics and Astronomy (Master's Level)</a>	6	B

### 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 phenomena 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.