

## Topics in Nanoscience (C004144)

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

**Credits 4.0**                      **Study time 120 h**

**Course offerings and teaching methods in academic year 2024-2025**

A (semester 2)                      English                      Gent                      independent work  
lecture

**Lecturers in academic year 2024-2025**

Geiregat, Pieter	WE06	lecturer-in-charge
Hens, Zeger	WE06	co-lecturer
Moreels, Iwan	WE06	co-lecturer

**Offered in the following programmes in 2024-2025**

	crdts	offering
<a href="#">Master of Science in Teaching in Science and Technology(main subject Chemistry)</a>	4	A
<a href="#">Master of Science in Chemistry(main subject Materials and Nano Chemistry)</a>	4	A
<a href="#">Master of Science in Chemical Engineering</a>	4	A
<a href="#">Master of Science in Chemical Engineering</a>	4	A
<a href="#">Master of Science in Materials Engineering</a>	4	A
<a href="#">Master of Science in Sustainable Materials Engineering</a>	4	A
<a href="#">Exchange Programme in Chemistry (master's level)</a>	4	A

**Teaching languages**

English

**Keywords**

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

**Position of the course**

Topics in Nanoscience 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 Self-assembly of nanostructures
- 4 Quantum Transport: Electron tunneling, Coulomb blockade, spin polarized transport.
- 5 Linear and non-linear Optical properties.
- 6 Study of Nanomaterials through Femtosecond Laser Spectroscopy
- 7 Biomedical and other emerging applications of nanomaterials

**Initial competences**

Intermediate knowledge of

- Chemistry
- Solid state Physics
- 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 basic non-linear light matter interactions related to nanomaterials.
- 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, Independent work

### **Study material**

Type: Handouts

Name: Handouts'

Indicative price: Free or paid by faculty

Optional: no

Additional information: English language course text. A selection of recent papers from literature and slides available through UFORA.

### **References**

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### **Course content-related study coaching**

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

### **Assessment moments**

end-of-term assessment

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

Oral assessment, Assignment

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

### **Examination methods in case of permanent assessment**

### **Possibilities of retake in case of permanent assessment**

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.

- Written report 10/20
- Presentation 10/20