

## Nanomagnetism (C004105)

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

**Credits 6.0** **Study time 180 h**

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

A (semester 1)	English	Gent	lecture seminar independent work
B (semester 2)	English	Gent	lecture independent work seminar

**Lecturers in academic year 2024-2025**

Van Waeyenberge, Bartel	WE04	lecturer-in-charge
Leliaert, Jonathan	WE04	co-lecturer

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

	crdts	offering
Master of Science in Teaching in Science and Technology (main subject Physics and Astronomy)	6	A, B
Master of Science in Physics and Astronomy	6	A, B

**Teaching languages**

English

**Keywords**

Magnetism, ferromagnetic and antiferromagnetic materials, spin transport, magnetization dynamics, nano magnets

**Position of the course**

Advanced course in solid state physics. This course aims at giving the students the basic ingredients to understand the contemporary research going on in the field of magnetism and magnetic nanostructures. Emphasis is laid on research related to activities in Gent.

**Contents**

- 1 Introduction: Modern magnetism: what, why and how
- 2 Basic concepts of magnetism: magnetic ordering and phase transitions – exchange interaction – magnetic anisotropies - magnetostatics – magnetic microstructure: domains and domainwalls – magnetization dynamics: Landau-Lifshitz-Gilbert equation
- 3 Experimental and computational techniques: Interaction with Light - X-rays – Neutrons, Micromagnetic simulations
- 4 Magnetism on the nanoscale: magnetostatics – magnetic interfaces: exchange bias and magnetic multilayers - magnetization dynamics: spin wave modes – spin dependent transport (GMR, TMR) - spin transfer torque
- 5 Discussion of research papers

**Initial competences**

Basic knowledge of quantum mechanics, material science, solid state physics.

**Final competences**

- 1 Acquiring a fundamental knowledge on magnetism and be able to apply it to the field of nano magnetism.
- 2 Understanding the principles of the experimental and computation methods

used to study magnetic systems.

3 Having an overview of the new concepts and challenges in the contemporary magnetism research.

#### **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**

Seminar, Lecture, Independent work

#### **Extra information on the teaching methods**

The lectures and excersisessions will be organized in an interactive way. Some session will be used to get in touch with experimental and computational methods.

#### **Study material**

Type: Handbook

Name: Magnetism and Magnetic Materials

Indicative price: € 60

Optional: no

Language : English

Author : J. M. D. Coey

ISBN : 978-1-10871-751-9

Number of Pages : 631

Online Available : Yes

Type: Handbook

Name: Magnetism: From Fundamentals to Nanoscale Dynamics, chapter 10

Indicative price: Free or paid by faculty

Optional: no

Language : English

Author : Stöhr, J., Siegmann, H.C.

ISBN : 978-3-54030-282-7

Number of Pages : 40

Online Available : Yes

Type: Slides

Name: Lectures

Indicative price: Free or paid by faculty

Optional: yes

Language : English

Number of Slides : 300

Available on Ufora : Yes

#### **References**

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

The students can consult the lectures personally and electronically

#### **Assessment moments**

end-of-term and continuous assessment

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

Oral assessment, Written assessment with open-ended questions, Written assessment open-book

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

Oral assessment, Written assessment with open-ended questions, Written assessment open-book

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

Presentation

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

examination during the second examination period is possible

#### **Extra information on the examination methods**

Oral examination with written preparation for the theory part (Periodic Evaluation).

Oral presentation of a research paper in front of the peers (Permanent Evaluation)

**Calculation of the examination mark**

3/4 Periodic Evaluation + 1/4 Permanent evaluation