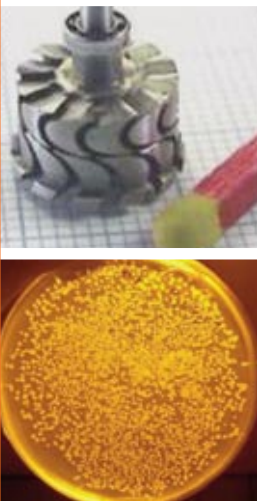




KATHOLIEKE UNIVERSITEIT
LEUVEN



Master of Nanoscience and Nanotechnology

Majors:

- Engineering
- Bioscience Engineering
- Natural Sciences

Faculty of Engineering
Faculty of Bioscience Engineering
Faculty of Science



Nanoscience studies phenomena and manipulation on the atomic and molecular scale (nanometers: i.e., one billionth of a meter). Important properties such as the electrical, optical and mechanical properties are determined by the way molecules and atoms assemble into larger structures on the nanoscale.

Nanotechnology is the application of this science in new nanomaterials and nano-concepts for new components, systems and products. Therefore, nanotechnology will provide us with the ability to design custom-made materials with any property we require.



These newborn scientific disciplines are situated at the interface of physics, chemistry, material science, microelectronics, biochemistry and biotechnology. Consequently, control of these disciplines requires an academic and multidisciplinary scientific education.

In the **Master of Nanoscience and Nanotechnology**, you will learn the basics of physics, biology and chemistry on the nanometer scale, complemented by courses on technology and engineering to ensure practical know-how. The programme fits into the growing worldwide convergence between these different basic sciences, and between science, technology and engineering sciences in general.

The programme is **strongly research oriented**, and is largely based on the research of centres like IMEC (Inter-university Microelectronics Center), the Leuven Nanocenter and INPAC (Institute for Nanoscale Physics and Chemistry) at the Faculty of Science, which are both global research leaders in nanoscience and nanotechnology. In your Master's thesis, you will have the opportunity to work in the exciting research programmes of these institutes.

As a graduate of the Master of Science in Nanosciences and Nanotechnology programme, you will have **thorough scientific knowledge of the fundamental structures of physical, biological and chemical systems in terms of their molecular and atomic characteristics**. You will also understand the formation of complex macro systems, which are unique in their operations and possess new functionalities, based on their molecular and atomic properties.

The objective of the Master of Nanoscience and Nanotechnology is to provide top-quality university multidisciplinary education in nanoscience as well as in the use of nanotechnologies for systems and sensors on the macro-scale. The programme comprises the disciplines of the three contributing faculties:

- Science: Departments of Physics and Chemistry
- Engineering: Departments of Electrical Engineering and Material Sciences
- Bioscience Engineering

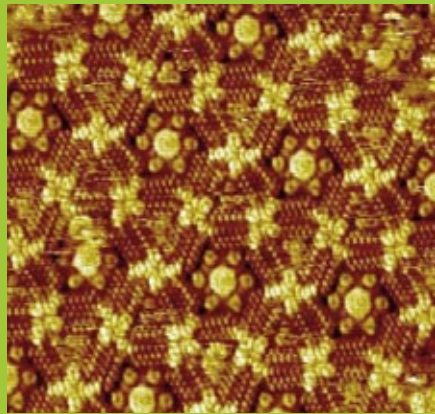
Various members of the teaching staff are connected to IMEC, bringing a strong nano-electronic component to the programme. The courses are taught in English. The nanosciences are multidisciplinary. You will receive basic training in nanoscale physics, chemistry, biology, bio-chemistry, material science and electronics. Special courses are designed to offer thinking across the boundaries of these traditional scientific disciplines. This knowledge is complemented by courses in modern nanoelectronics and complex electronic systems, teaching students how nanosciences bring about innovation for humankind.

The programme is strongly connected to the latest innovations in the field. The courses are continuously updated following the progress of science and technology in this young and highly innovative field. Furthermore, you will spend one fourth of the study programme elaborating your own research project in a Master's thesis. There is ample room for elective courses, either to increase your level of proficiency, or to broaden your horizon, according to your own interest.

Admission requirements

Direct access:

- Bachelor in de ingenieurswetenschappen: chemische technologie
- Bachelor in de ingenieurswetenschappen: computerwetenschappen, met nevenrichting elektrotechniek
- Bachelor in de ingenieurswetenschappen: elektrotechniek
- Bachelor in de ingenieurswetenschappen: materiaalkunde
- Bachelor in de ingenieurswetenschappen: werktuigkunde, met nevenrichting: chemische technologie / elektrotechniek / materiaalkunde
- Bachelor in de fysica
- Bachelor in de bio-ingenieurswetenschappen
- Bachelor in de chemie
- Bachelor in de biochemie en de biotechnologie
- Bachelor in de biologie



Admission decisions are based upon evaluation of a complete application file:

- Bachelor of Engineering
- Bachelor of Physics
- Bachelor of Chemistry
- Bachelor of Biochemistry
- Bachelor of Electrical Engineering
- Bachelor of Materials Science
- Bachelor of Bioscience Engineering

If you are not a native speaker, you must present proof of a test of English proficiency. Requirements: a 75% grade point average and the TOEFL paper test (550) or computer test (213), indicating a C-1 level on the Common European Framework of the Council of Europe.

Profile

You have strong analytic, synthetic and interpretive skills and a clear interest in both fundamental sciences as well as technological problems. You should be able to understand a large variety of problems and to translate them onto an abstract academic level. You should be interested in how and why systems function, and at the same time have a clear sense of the social and psychological relevance of technology and its implications for society. From your Bachelor's education, you have basic knowledge of mathematics, physics, organic and inorganic chemistry, cell biology and biochemistry, molecular and atomic architecture, material science, electronics, and electromagnetism. You have shown excellence in your study results, as well as sufficient knowledge of English.

Programme

The structure of the Master's programme is shown in the figure opposite and consists of six parts:

- 1) In the **introductory courses** (max. 15 credits), you will learn the basics of the disciplines you missed during your Bachelor's training. If, however, you have followed these courses during your Bachelor's programme, you will compensate for these credits with elective courses.
- 2) The **non-technical courses** (9-12 credits) are required to learn non-technical skills. Modules such as scientific writing skills, entrepreneurship and intellectual property are offered.
- 3) The **core courses** (36 credits) provide you with the basic knowledge of the programme's core disciplines: nanotechnology, nanoscience, biochemistry and physics. You have to follow these courses irrespective of your specialisation. Moreover you have to choose a project-based practical course and follow a series of lectures on current topics in nanoscience and nanotechnology.
- 4) The **specific courses** (15 credits) introduce specialisation into the programme. There are three majors: Engineering, Bioscience Engineering and Natural Sciences. Depending on your major, you can choose one of five specific course clusters, from which you follow all compulsory courses.
- 5) The **broadening courses** (12-30 credits) allow you to broaden your horizon with specific courses from the other specialisations. You can choose courses from all other specific course clusters and from three extra clusters. You can also do an industrial internship during the summer between the two Master's years (6 stp).
- 6) The **Master's thesis** (30 credits) is intended to introduce you to a multidisciplinary research environment. You will be assigned to a relevant research project and work in close collaboration with PhD students, postdoctoral fellows and professors. The research project culminates with the public defence of the Master's thesis.

Master of Nanoscience and Nanotechnology (120 credits)

Introductory Courses (0-15 credits)

Non-technical Courses (9-12 credits)

Core Courses (36 credits)

Engineering Major

Specific Courses
(15 credits)
Cluster 1 or Cluster 2

Broadening Courses
12-30 credits electives
from clusters 1-8
or 6-24 credits + Intern

Master's Thesis
(30 credits)

Natural Sciences Major

Specific Courses
(15 credits)
Cluster 5 or Cluster 6

Broadening Courses
12-30 credits electives
from clusters 1-8
or 6-24 credits + Intern

Master's Thesis
(30 credits)

Bioscience Engineering Major

Specific Courses
(15 credits)
Cluster 4

Broadening Courses
12-30 credits electives
from clusters 1-8
or 6-24 credits + Intern

Master's Thesis
(30 credits)

MASTER OF NANOSCIENCE AND NANOTECHNOLOGY

120

COURSES

CREDITS

Introductory Courses

max. 15

- Basic Electronic Circuits 3
- Semiconductor Physics 3
- Quantum Physics 3
- Semiconductor Devices 3
- Structure, Synthesis and Cellular Function of Macromolecules 3
- Atoomtheorie, chemische periodiciteit en chemische binding (Dutch only) 3

Non-technical Courses

9-12

Courses can be selected from an extensive list on a variety of topics

COURSES	CREDITS
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Core Courses	36
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• Materials Physics and Technology for Nanoelectronics	6
• Nanostructured Bio-Macromolecules	6
• Chemistry at Nanometre Scale	6
• Technology of Integrated Systems	6
• Advanced Nano-Electronic Components	3
• Mesoscopic Physics	3
• Lectures Series on Nanoscience and Nanotechnology	3
• Practical Design for Micro- and Nanoelectronics OR Projectwork Nanoscience	3

Specific Courses	15
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Engineering Major	
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Choose one of the two clusters:

• Cluster 1: Device Implementation	15
- Models and Technology of Electronic and Optoelectronic Devices	3
- Integrated RF Components and Circuits	3
- Microsystems and Sensors	3
- Reliability and Yield for Micro- and Nanoelectronics	3
- Physical Material Characterisation Techniques for Electronic Devices	3
• Cluster 2: Electronics 1	15
- Transistor Models and Electronic Circuits	6
- Design of Digital Integrated Circuits	6
- Computer Architectures	3

Bio-engineering Major	
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• Cluster 4: Bionanotechnology	15
- Biosensors and Bioelectronics	3
- Nanobiology	3
- Micro- and Nanofluidics	6
- Biomachines and Biomimetics	3

Natural Science Major	
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Choose one of the two clusters:

• Cluster 5: Nanochemistry	15
- Physical Chemistry of Polymers	3
- Electronic Structure of Molecular Materials	3
- Nanostructure Determination via Electromagnetic Radiation	3
- Photophysics and Photochemistry of Molecular Materials	3
- Electrochemical Methods of Inorganic Chemistry	3
• Cluster 6: Nanophysics	15
- Scanning Probe Microscopy	3
- Optical Properties of Solids	3
- Computational Methods in Solid State Physics	3
- Magnetic Resonance	3
- Electronic Transport	3

COURSES**CREDITS****Master's Thesis****30****Broadening Courses****12-30**

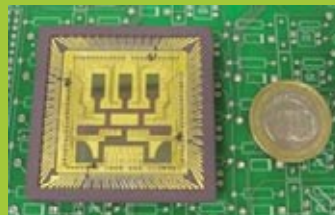
Courses can be selected from all specific clusters and from 3 additional clusters.

- Cluster 3: Electronics 2
- Cluster 7: Materials
- Cluster 8: Biological Systems

For detailed descriptions of this programme's courses and for the course timetable, please consult www.kuleuven.be/onderwijs/aanbod/opleidingen/E

Career prospects

In the coming decades, nanoscience and nanotechnology will undoubtedly become the driving force for a new set of products, systems and applications. They are even expected to become the basis for a new industrial revolution.



Within a few years, nanoscience applications are expected to impact virtually every technological sector and ultimately many aspects of our daily life. In the coming five-to-ten years, many new products and companies will emerge based on nanotechnology and nanosciences. These new products will stem from the knowledge developed at the crossroads of the various scientific disciplines offered in this Master's programme.

As a result, the students who graduate as masters of nanosciences and nanotechnology will be joining companies developing these new technologies. The graduates will be able to go into R&D as well as industry. In the coming years, there will be a strong need for scientists and engineers whose expertise is precisely at the crossroads of these various disciplines, and these engineers will end up in jobs directly aligned to the education offered in this Master's programme. You might be employed by companies in the electronics sector, new and smart material industry, chemical technology, and biotechnology companies. As a graduate of the programme, you will have an ideal background to become the link between experts in all these disciplines and you will be able to use your broad perspective of nanotechnology to develop and create new products or even start up completely new companies. With your basic education, you might also end up in R&D (research & development), product design, or product development, and you will have the skills required to become an independent consultant.

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General Information

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www.kuleuven.be/english

K.U.Leuven - International programmes

www.kuleuven.be/internationalprogrammes

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This brochure provides the most complete information available for this Master's programme offered by K.U.Leuven during the 2010-2011 academic year. However, small changes to the composition of the programmes may be approved after the publication of this brochure. In no way is the university legally bound by the information provided in this brochure. The most recent information on all our academic programmes can be consulted on www.kuleuven.be/onderwijs/aanbod/opleidingen/E.

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