

**At Louvain-la-Neuve - 60 credits - 1 year - Day schedule - In French**Dissertation/Graduation Project : **YES** - Internship : **YES**Activities in English: **optional** - Activities in other languages : **NO**Activities on other sites : **optional**Main study domain : **Sciences de l'ingénieur et technologie**Organized by: **Louvain School of Engineering (EPL)**Programme acronym: **NANO2MC** - Francophone Certification Framework: 7**Table of contents**

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## NANO2MC - Introduction

### Introduction

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#### Introduction

The programme trains in the multidisciplinary aspect of nanotechnologies and offers five specialisations:

- nanophysics: quantum phenomena, molecular transports, spintronics, simulation, physical characterisations, etc.;
- nanochemistry: synthesis of nanoparticles, chemical and physico-chemical characterisation, quantum chemistry, etc.;
- nanoelectronics: micro- and nanoelectronics, MEMS, NEMS, electronic characterisation, etc.;
- nanomaterials: nanocomposites, nanofibres, nanotubes, polymers, etc.;
- nanobiotechnologies: biomaterials, biophysics, nanomedicine, biosensors, etc.

#### Your profile

This programme is accessible to:

- holders of a master (120) in engineering sciences;
- holders of a master degree (120) in agronomic sciences and bioengineering, sciences, biomedical and pharmaceutical sciences, as well as holders of the academic degree of master in Business Engineering: upon application for admission;
- holders of Belgian and foreign second-cycle degrees: upon application for admission.

#### Your programme

In each of the specialisations, the training programme is composed of at least 60 credits.

This programme includes:

- a common core of 30 credits including a research work (thesis) done in a laboratory of one of the six institutions organising the Master (27 credits), transversal seminars and a personnel work (3 credits);
- a specialised training (8 to 15 credits);
- options in the form of courses of your choice (15 to 22 credits).

## NANO2MC - Teaching profile

### Learning outcomes

The Advanced Master in Nanotechnology offers holders of a basic second cycle degree complementary and/or advanced second cycle training in the fields of nanoscience and nanotechnology. It is intended for, on the one hand, those who do not have any training in this field and who wish to specialise in it, or on the other hand, for those who have already taken an option in this field during their Master's and who wish to further their training with a specialisation in another area of nanotechnology, e.g. an electrical engineer wanting to further his/her training in nano-biotechnology.

The Advanced Master in Nanotechnology is a program of 60 credits organised around five main areas of specialisation:

- nanophysics: quantum phenomena, molecular transportation, spintronics, simulation, physical characterisations ...
- nanochemistry: synthesis of nanoparticles, chemical and physico-chemical characterisation, quantum chemistry
- nanoelectronics: micro and nanoelectronics, MEMS, NEMS, electronic characterisation ...
- nanomaterials : nanocomposites, nanofilms, nanotubes, nanomedicine, biocaptors ...

This program is also intended to train students in the multidisciplinary aspect of nanotechnology. To this end it puts the accent on the different approaches used in these fields : knowledge of basic phenomena at the nano level, nanomanufacturing or the synthesis of nanostructures, the characterisation of nanostructures and the modelling and numeric simulation at the nano level

It also aims to make students aware of the impact on society of nanotechnology by way of interdisciplinary seminars on the following themes : ethics, economic perspectives, applications of nanotechnology, toxicity of nanomaterials ...

On successful completion of this programme, each student is able to :

1. mener à son terme une démarche multidisciplinaire de recherche appliquée à la conception et à la fabrication d'un objet fonctionnel dont la taille se situe entre 1 et 100 nm et notamment d'être en mesure d'appliquer au moins deux des quatre compétences suivantes :
  - 1.1. utilisation des notions de phénomènes fondamentaux à l'échelle nanoscopique en vue de concevoir des objets et de matériaux aux propriétés nouvelles,
  - 1.2. synthèse de nanomatériaux ou fabrication de nanostructures fonctionnelles en laboratoire,
  - 1.3. caractérisation des nanostructures pour en connaître la structure et/ou des propriétés fonctionnelles,
  - 1.4. modélisation ou simulation numériquement à l'échelle nanoscopique, en utilisant des outils non-conventionnels, pour prédire des propriétés de l'objet, du matériau ;
2. appliquer la démarche complète de recherche au développement d'un objet fonctionnel dans l'un des domaines suivants : nanophysique, nanochimie, nanoélectronique, nanomatériaux, nanobiotechnologies ;
- /
3. estimer l'impact des nanotechnologies sur l'environnement, la santé, le développement économique, l'emploi ;
- /
4. organiser son travail de recherche, en équipe de laboratoire, pour le mener à bien
  - 4.1. formuler le cahier des charges du nanomatériau ou du nanodispositif,
  - 4.2. se documenter et résumer l'état des connaissances actuelles dans le domaine de recherche en nanotechnologie,
  - 4.3. mettre en forme un rapport de synthèse visant à expliciter les nouvelles propriétés de l'objet, du matériau, son domaine d'application,
  - 4.4. communiquer oralement et par écrit (sous forme d'article scientifique) les résultats de sa recherche à une équipe d'experts dans le domaine des nanotechnologies.

### Programme structure

In each of the areas of specialisation, the program involves a minimum of 60 credits. This program comprises :

- a core curriculum of 30 credits consisting of
  - . a research work (thesis) carried out in a laboratory of one of the six institutions organising the Master's (27 credits)
  - . interdisciplinary seminars and an individual assignment (3 credits) : students follow seminars common to the various streams and do an assignment on some interdisciplinary themes such as ethics, economic perspectives, applications of nanotechnology, toxicity

of nanomaterials ... ; these seminars are organised in turn by the program partners in the form of thematic days ; the interdisciplinary seminars are compulsory for all the streams and involve all the Master's students.

- specialised training (8 to 15 credits) made up of four basic courses in each of the four disciplines (basic phenomena, nanomanufacturing or nanosynthesis, characterisation of nanostructures and simulation at the nano level) : several basic courses are offered for each of the disciplines, in each of the areas of specialisation, adapted to the previous knowledge of the students ; students will be obliged to choose at least one course in each of the four disciplines

- options in the form of electives (15 to 22 credits)

. in function of their previous studies, students will be able to take general courses (maximum 9 credits), in particular in the chemistry and physics of solids, the chemistry and physics of macromolecules, biochemistry and biophysics ...

. students will specialise in one of the five research or application areas while following specialised courses ; they will devise a multidisciplinary training program in function of the topic of their research work.

Within the area of specialisation, students will, with the assistance of an adviser, devise a coherent program which is adapted to their previous knowledge. With the agreement of their adviser, it is possible to take electives outside the area of specialisation, even out of the Master's program. If during their previous studies students have already taken a particular course or one deemed equivalent, they cannot include this in their program.

Whatever the area of specialisation, the program will comprise a minimum of 60 credits. It may be raised to 75 credits if intensive upgrading courses are considered necessary by the committee responsible for the program in function of the student's previous studies (see admission conditions). The program thus constituted will be submitted for approval to the inter-academic committee responsible for the Master's.

[> Programme détaillé du master de spécialisation en nanotechnologie](#) [ en-prog-2020-nano2mc-tronc\_commun ]

## NANO2MC Detailed programme

### Programme by subject

#### CORE COURSES [60.0]

The program of this master's degree is inter-university. In the lists of teaching units below, the codes of teaching units organised by UCLouvain are preceded by the letter L, those organised by another institution have a code preceded by the letter E. By clicking on the title of the course, you will arrive at its description sheet, which will give you detailed information.

○ Mandatory

△ Courses not taught during 2020-2021

⊕ Periodic courses taught during 2020-2021

⊗ Optional

⊖ Periodic courses not taught during 2020-2021

■ Activity with requisites

Click on the course title to see detailed informations (objectives, methods, evaluation...)

#### ○ Tronc commun du master de spécialisation en nanotechnologie

Les étudiants réalisent un travail de recherche dans un labo d'une des 6 institutions organisant le Master. Ils suivront des séminaires communs aux différentes filières et réaliseront un travail sur un des thèmes transversaux tels que l'éthique, les aspects socio-économiques, les applications des nanotechnologies et la toxicité des nanomatériaux

○ LNANO2991	Seminars on the ethical and socio-economical aspects of nanotechnologies		15h+15h	3 Credits	q2
○ LNANO2990	Master Thesis			27 Credits	

○ -

L'étudiant suivra au moins un cours de formation de "base" dans chacune des 4 disciplines ci-dessous ( phénomènes fondamentaux, nano-fabrication, caractérisation des nanostructures et simulation à l'échelle nanoscopique) pour un volume de Minimum 8 credits

⊗ -

ENANO2801	Chimie des Interfaces et nanostructures		36h+24h	5 Credits	q1
ENANO2802	Théorie quantique de l'état solide organique		15h	3 Credits	q1
ENANO2803	Advanced Theoretical Chemistry (UNamur, Cours SCHIM102)		37.5h+30h	6 Credits	q1
ENANO2804	Nanochemistry and Nanotechnology		24h+24h	4 Credits	q2
ENANO2805	Nanophysics		24h+24h	5 Credits	q1
ENANO2806	Molecular motors and stochastic processes		36h+24h	5 Credits	q1
ENANO2807	Chimie des macromolécules biologiques		20h	2 Credits	q2
ENANO2808	Nanoelectronics / optoelectronics		30h+40h	5 Credits	q2
ENANO2809	Morphogenesis and Instabilities		15h+15h	4 Credits	q2
ENANO2810	Physics of functional oxides		20h+10h	4 Credits	q1
LELEC2710	Nanoelectronics	Vincent Bayot (coord.) Benoît Hackens	30h+30h	5 Credits	q1
LMAPR2015	Physics of Nanostructures	Jean-Christophe Charlier (coord.) Xavier Gonze Luc Piraux	37.5h+22.5h	5 Credits	q1
ENANO2811	Introduction aux phénomènes relativistes en chimie		15h	3 Credits	q2 ⊕
ENANO2812	Nanomaterials and applications of solid state physics		45h+15h	6 Credits	q2
ENANO2813	Interaction rayonnement-matière		30h+30h	6 Credits	q1
ENANO2814	Physique des lasers, optique non-linéaire et quantique		45h+15h	6 Credits	q1
ENANO2815	Science and Energy		30h	3 Credits	q1
ENANO2816	Photonique théorique et numérique		30h+15h	3 Credits	q2
ENANO2817	Plasmonique et applications		15h+15h	3 Credits	q2

#### ⊗ Filière spécialisée en nano-fabrication, nano-manipulation ou nano-synthèse du master de spécialisation en nanotechnologie

ENANO2701	Biocompatible and nanostructured materials		36h+24h	5 Credits	q2 ⊗
ENANO2702	Nanomaterials, (electro)synthesis and applications		25h	2 Credits	q1
ENANO2703	Matériaux nanocomposites polymères		15h+15h	3 Credits	q2
ENANO2704	Microfabrication techniques		24h+12h	5 Credits	q1+q2
ENANO2705	Introduction to microsystems and microtechnology		20h+16h	5 Credits	q2
ENANO2706	Ingénierie des nanomatériaux et matériaux divisés		15h+15h	3 Credits	q1
LELEC2560	Micro and Nanofabrication Techniques	Laurent Francis (coord.) Benoît Hackens Jean-Pierre Raskin	30h+30h	5 Credits	q2
ENANO2707	Synthèse des matériaux		30h	3 Credits	q1

#### ⊗ Filière spécialisée en caractérisation des nanostructures du master de spécialisation en nanotechnologie

ENANO2601	Physics of semiconductors		10h+5h	2 Credits	q1
ENANO2602	Spectroscopy of materials		20h+10h	4 Credits	q1
ENANO2603	Microscopie électronique		22h+8h	3 Credits	q1 ⊕
ENANO2604	Surface physics and surface characterization		24h+12h	3 Credits	q2
ENANO2605	Characterization of nanostructures by scanning probe techniques		15h	2 Credits	q1
ENANO2606	Microscopie à sonde locale		15h+15h	3 Credits	q2
ENANO2607	Surface Analysis of Materials		24h+12h	5 Credits	q2
LBRNA2102	Material surface characterisation	David Alsteens Christine Dupont (coord.) Eric Gaigneaux	45h	5 Credits	q2
LELEC2541	Advanced Transistors	Denis Flandre (coord.) Benoît Hackens Jean-Pierre Raskin	30h+30h	5 Credits	q2
LMAPR2631	Surface Analysis	Arnaud Delcorte Bernard Nysten	30h+15h	5 Credits	q2
ENANO2608	Optique expérimentale des Surfaces et des Nanostructures		22h	3 Credits	q1 ⊕
ENANO2609	Caractérisation microstructurales des matériaux		25h	2 Credits	q2
ENANO2610	Microscopy applied to materials chemistry		15h	3 Credits	q2
ENANO2611	Techniques de caractérisation des surfaces et interfaces		30h	3 Credits	q1
ENANO2612	Nanofabrication: principles and techniques		25h+15h	4 Credits	q2

### ⊗ Filière spécialisée simulation à l'échelle nanoscopique du master de spécialisation en nanotechnologie

ENANO2501	Simulation en Physique des Matériaux		15h+15h	3 Credits	q1
ENANO2502	Modélisation Moléculaire en Chimie		15h+15h	3 Credits	q1
ENANO2503	Quantum modelling of materials properties		20h+10h	4 Credits	q1
ENANO2504	Théorie et Modélisation des Hybrides		15h	3 Credits	q1
ENANO2505	Physics of Nanomaterials		20h+10h	4 Credits	q1
ENANO2506	Approches computationnelles des états de la matière		36h+24h	5 Credits	q1
LMAPR2451	Atomistic and nanoscopic simulations	Jean-Christophe Charlier Xavier Gonze Gian-Marco Rignanese	30h+30h	5 Credits	q2
ENANO2507	Compléments de Chimie quantique		15h	3 Credits	q2

### o Cours au choix du master de spécialisation en nanotechnologie

En fonction de sa formation préalable, l'étudiant peut suivre une formation générale de mise à niveau de 9 crédits maximum. Les étudiants suivent en outre de 10 à 22 crédits d'unités d'enseignement au choix dans leur option de spécialisation, ou éventuellement en dehors de celle-ci avec l'accord de leur conseiller.

ENANO2401	Interactions intermoléculaires		15h	3 Credits	q2
ENANO2402	Solid State Properties of Polymers		24h+24h	5 Credits	q2
ENANO2403	Micro- and Nanobiotechnology		12h	3 Credits	q2
ENANO2404	Magnetic Resonance Imaging and Biomedical Nanotechnology		48h+12h	5 Credits	q2
ENANO2405	Apport de l'électrochimie à la chimie macromoléculaire		10h	1 Credits	q2
ENANO2406	Application des nanotechnologies au développement de nouveaux médicaments		10h	1 Credits	q2
ENANO2407	Molecular logic		25h	2 Credits	q1
ENANO2408	Microfluidics		22h+38h	5 Credits	q1
ENANO2409	Introduction aux nanotechnologies		15h	2 Credits	q1
ENANO2410	Molecular and Biomolecular Engineering		24h+12h	3 Credits	q2
ENANO2411	Soft microrobotics		24h+36h	5 Credits	q1+q2
ENANO2412	Biologie structurale		25h+15h	4 Credits	q1
ENANO2413	Protéomique		20h+10h	3 Credits	q2
ENANO2415	Physics of magnetic materials		20h+10h	4 Credits	q2
ENANO2414	Introduction à la matière molle et aux systèmes complexes		30h	4 Credits	q1
ENANO2416	Nanotechnologies		15h	3 Credits	q2
LBRNA2202	Nano-biotechnologies	Yves Dufrêne	30h	3 Credits	q2
LELEC2550	Special electronic devices	Vincent Bayot	30h+30h	5 Credits	q1
LELEC2895	Design of micro and nanosystems	Laurent Francis	30h+30h	5 Credits	q1
LMAPR2012	Macromolecular Nanotechnology	Sophie Demoustier Karine Glinel Karine Glinel (compensates Bernard Nysten) Jean-François Gohy	45h+15h	5 Credits	q2
LMAPR2471	Transport phenomena in solids and nanostructures	Jean-Christophe Charlier Luc Piraux	30h+30h	5 Credits	q2
ENANO2417	Nanotechnologie des Formes à Libération Contrôlée		15h	2 Credits	q2
LPHYS2245	Lasers physics	Clément Lauzin	22.5h+7.5h	5 Credits	q2
LBRNA2201	Principles in heterogeneous catalysis	Eric Gaigneaux	52.5h	5 Credits	q1
LSTAT2310	Statistical quality control.	Bernard Francq	15h+5h	4 Credits	q1
ENANO2418	Physical chemistry of interfaces		20h+10h	3 Credits	q2
ENANO2419	Organic photochemistry		15h	3 Credits	q2
ENANO2420	Physics of materials for energy			4 Credits	

## The programme's courses and learning outcomes

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For each UCLouvain training programme, a [reference framework of learning outcomes](#) specifies the competences expected of every graduate on completion of the programme. You can see the contribution of each teaching unit to the programme's reference framework of learning outcomes in the document *"In which teaching units are the competences and learning outcomes in the programme's reference framework developed and mastered by the student?"*

## NANO2MC - Information

### Access Requirements

*In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.  
Decree of 7 November 2013 defining the landscape of higher education and the academic organization of studies.  
The admission requirements must be met prior to enrolment in the University.*

***In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.***

#### SUMMARY

- [General access requirements](#)
- [Specific access requirements](#)

### General access requirements

Subject to the general requirements laid down by the academic authorities, admission to the specialized Master's degree programme will be granted to students who fulfil the entry requirements for studies leading to the award of a Master's (second-cycle) degree and who hold a second-cycle diploma, degree, certificate or other qualification issued within or outside the French Community of Belgium, or whose prior learning or experience has been accredited by the Examination Board as being equivalent to at least 300 credits.

### Specific access requirements

#### Specific Admission Requirements

In accordance with the decree of 31 March 2004 on higher education, encouraging the integration of higher education and financing universities within Europe, the general admission conditions are set out on the website « Conditions d'admission - Masters de spécialisation : <https://uclouvain.be/fr/etudier/inscriptions/conditions-masters-specialisation.html>

The specific admission conditions to this program are as follows :

- 1) Access to the Advanced Master in Nanotechnology is unconditional for holders of a Master's degree of at least 120 credits in study area No.19 of the Sciences de l'Ingénieur : Master in Engineering (ir.) awarded by the French-speaking community of Belgium, as well as holders of a similar degree awarded by the Dutch-speaking community of Belgium.
- 2) Access to the Advanced Master in Nanotechnology is conditional for holders of a Master's degree with at least 120 credits in study areas No.18 in Agronomy and Bioengineering, No. 17 in Science, and No. 15 in Biomedicine and Pharmacy, as well as holders of the degree of Master in Management in the study area No. 10 of Economics and Management awarded by the French-speaking community of Belgium, as well as holders of a similar degree awarded by the Dutch-speaking community of Belgium.
- 3) Access to the Advanced Master in Nanotechnology is conditional for holders of a Master's degree other than those listed in 1) and 2), as well as holders of a second cycle foreign degree of at least 300 credits. The enrolment procedure is identical to that in 2).

Applications received will be subject to scrutiny by the program committee with a view to admission. The admission application should contain the following items : a letter of motivation, copy of the Master's degree or a document listing successful completion of the program and courses taken. A maximum of 15 credits of prerequisites may be imposed on candidates covered by points 2) and 3).

#### Personalized access

All Masters (apart from Advanced Masters) are also accessible on application, especially on validation of experience (VAE).

#### Prérequis :

sur dossier

> En savoir plus

#### Accessible to adults

All Masters (apart from Advanced Masters) are also accessible on application, especially on validation of experience (VAE).

Those who do not have a Master's degree in civil engineering awarded by the French-speaking Community of Belgium should submit an admission application to the committee responsible for the Master's (see Contact).



## Teaching method

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The Advanced Master in Nanotechnology is a resolutely multidisciplinary program, the objective of which is to train students in both theoretical, and experimental and applied approaches in the field of nanotechnology.

By its structure of leaving a very wide choice of courses, this program allows students to construct a program to suit them and their personal needs.

To minimise students' travelling, distance-learning (video-learning) accompanied by supervision will be progressively established.

A variety of the learning structures and scientific approaches is provided by the inter-university organisation of the program.

## Evaluation

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***The evaluation methods comply with the regulations concerning studies and exams (<https://uclouvain.be/fr/decouvrir/rgee.html>). More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading "Learning outcomes evaluation method".***

The learning activities are evaluated according to the regulations in force at the university (see the examination regulations), viz. written and oral examinations, laboratory examinations, individual or group assignments, public presentations of projects, thesis.

## Mobility and/or Internationalisation outlook

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To allow access to the Master's program to non-French speaking students, a major part of the program will be given in English.

Most of the laboratories of the teachers involved in the Master's program belong to European networks of excellence (FAME, SINANO, NANOSIL, ...), and international research programs.

## Possible trainings at the end of the programme

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The Advanced Master in Nanotechnology is intended in particular for holders of a degree in civil engineering, bioengineering, a master's in biology, chemistry, physics, biomedical science or management, wishing to specialise in this field, or advance their training in it. It is characterised by a global approach to the field of nanotechnology, and offers a deliberately multidisciplinary program.

The program is organised conjointly by six universities : FPMs, FUNDP, UCL, ULB, ULg et UMH; the courses are given in these universities. The research work is carried out in one of the laboratories of these universities which is active in the field of nanotechnology.

These laboratories are members of the Walloon association of nanotechnology (NanoWal). This association also includes research centres and companies active in this field. The students taking the Master's will also have the opportunity to study and carry out research in a resolutely multidisciplinary environment in laboratories which have a strong tradition of collaboration.

With its training and research components, the Advanced Master in Nanotechnology also prepares students for the PhD program. Most of the teachers involved in the Master's are members of the thematic doctoral school MAIN (Science et Ingénierie des Matériaux, des Interfaces et des Nanostructures) which can supervise students wishing to do a PhD.

## Contacts

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### Curriculum Management

Entity

Structure entity

Denomination

(IMCN)

Sector

Acronym

Postal address

SST/IMCN/BSMA

(BSMA)

Sciences and Technology (SST)

BSMA

Croix du Sud 1 - bte L7.04.02

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Jury

- Bernard Nysten
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