

# ENSCHEDÉ

THE MASTER DEGREES

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Master of Science Programme

**Nanotechnology**

**IMPROVE YOUR POSITION**



**University of Twente**  
Enschede - The Netherlands

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# Nanotechnology

## Master of Science

### What is Nanotechnology?

Nanotechnology aims at the design and creation of functional materials, structures, devices and systems through direct control of matter on the nanometer length scale and exploitation of novel phenomena and properties on this length scale. The length scale is usually defined as smaller than 100 nm, depending on the physical and chemical characteristics of the particular system that undergoes quantitative and qualitative changes when the length scale boundary is crossed. Nanotechnology research and development includes controlled manipulation of individual molecules and nano-scale structures and their integration into larger material components, systems and architectures. Within these larger scale assemblies the control and construction of their structures and components remains at the nanometer scale. Essential in nanotechnology is to have a direct control of matter either between two nano-objects, or between a micro (or macro) object and a nano-object.

### General information

Researchers and professors active in the fields of Applied Physics, Chemical Engineering and Electrical Engineering joined in to close the gap between scientific and technological progress and conventional disciplinary educational programs by setting up an interdisciplinary Master Program in Nanotechnology. Differences in background that you and the other applicants might have are not considered a problem, but an asset. Introductory modules and personal coaching (tutor) are offered to ensure a smooth connection between your background and the Master. Within this interdisciplinary program you will develop more competence and problem-solving skills compared to monodisciplinary, traditional expertise you would develop in any other Master program. This Master program contains a strong research component and is set up to prepare you to continue your research at a PhD level. You will learn to operate in a research environment, to set up, manage and perform research projects, including reporting and communicating the results. The Master will provide you with an in-depth overview of the enabling technologies and key aspects relevant for the field of nanotechnology.



## Program structure

This 2-year Master program (120 EC) is divided into 4 semesters. In the first year, semester 1 and 2, you will follow four core modules in Nanotechnology (25 EC). One module of 5 EC is reserved for self-study and the subject will depend on your BSc-background. Furthermore you will follow four elective modules selected from the disciplines Applied Physics, Chemical Technology, Electrical Engineering, Biomedical Engineering or any other applied science course, which is offered at the University of Twente. In the second semester, you will be offered a practical training in fabrication and characterization of nanostructures. The last item in the first year is a literature study, which encompasses writing a review paper and giving a presentation on the topic of your choice.

In the second year, semester 3 and 4, you will do an internship (obligatory for Dutch students) or research project in any group active in nanotechnology inside or outside the University of Twente or an industrial training at a company. The last 9 months are reserved for your MSc research project in one of the research groups in Nanotechnology. During this project you will learn to set up, plan, manage and perform a larger research project, based on which you will write your MSc thesis which you will defend in a presentation.

### Fabrication and characterization of nanostructures

This module will introduce the techniques that are available for creating nanostructures, both top-down (e.g. optical lithographic techniques) as well as bottom-up (self-assembly). Furthermore the wide range of characterization tools (XPS, SIMS, TEM, SEM, AFM, etc.) that are available to study materials at the nanometer scale will be dealt with in this module.

### Nanoscience: fundamentals and applications

Electronic structure of quantum dots, quantum wires and quantum wells and their transport properties will be addressed in this module as well as the vibration and thermal properties of low-dimensional systems.

### Nanooptics and nanoelectronics

In this module the items semi-conductor nano-electronic devices, spintronics and molecular electronics will be studied. Furthermore different topics such as light detection in nanostructures, optics in nanosized structures, and optics in periodic nano-structures will be discussed.

### Bionanotechnology and nanofluidics

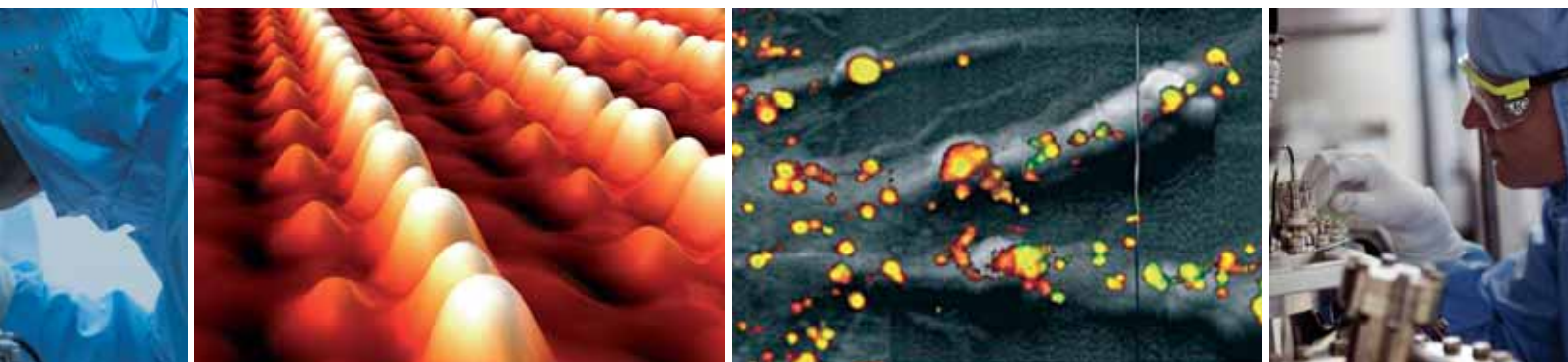
Topics as liquid structure near solid-liquid interfaces, hydrodynamic boundary conditions and electro-kinetic effects will be discussed. Furthermore this module will introduce you to subjects as structures of bio-molecules, recombinant DNA technology, interfacing bio with non-bio materials, etc.

### Self-study

Within this module you will study one or a few specific subjects, that are missing in your background but are required in order to start with the core modules. The specific subjects for you will be determined in discussion with your tutor. You are expected to study the material given with the help of an expert who at the end will evaluate you.

### Laboratory course

In this module you will get some practical (hands-on) training in different techniques used in the fabrication and characterization of nanostructures.



### Paper and presentation

You will conduct a thorough literature search and study on a specific topic in the field of nanotechnology. The results of this study you will report in a scientific paper and an oral presentation during a symposium in which all students will present their results.

### Elective modules

A course list is provided from which you can choose 4 courses of 5 EC each. Three courses should be selected from other MSc programs in applied sciences (Applied Physics, Chemical Technology, Electrical Engineering and Biomedical Engineering) given at the University of Twente. The fourth one can be one from any other MSc program. 10 EC of the elective courses can be used to do a small research project. In this case you will conduct some research work in one of the research groups active in nanotechnology. This work will be concluded with a scientific report and an oral presentation.

### Internship or Industrial Training

For a 3-month period you will participate in an industrial training at a company involved in nanotechnology, or complete an internship at another university or research institute. For Dutch students an industrial training is obligatory. For international students there is a choice to do either an internship/industrial training or a research project in any of the research groups at the University of Twente.

### Master project

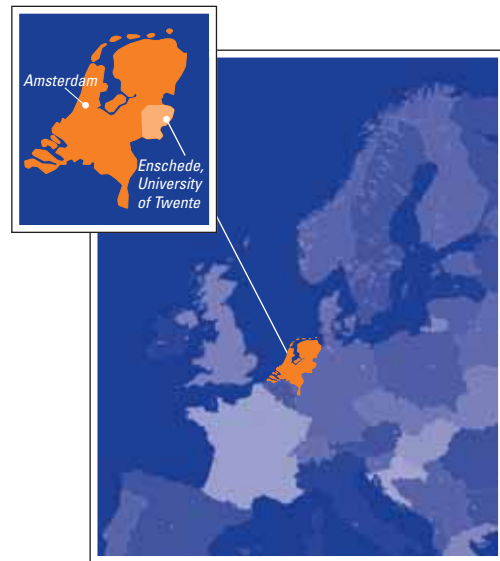
The final 9 months are reserved for your MSc project. You will set up and conduct a full research project in one of the participating research groups. Starting with an extensive literature study (reported in a literature report) you will continue doing experimental work in the field of nanotechnology. Both the literature report and your results will be reported upon in your Master thesis which you will defend in a presentation before a public audience.

Semester 1	Fabrication and characterization of nanostructures (10 EC)	Nanoscience (5 EC)	Self-study (5 EC)
		Nano-optics and nano-electronics (5 EC)	Elective (5 EC)
Semester 2	Practicum (5 EC)	Bionanotechnology and nanofluidics (5 EC)	Elective (5 EC)
	Paper and presentation (5 EC)	Elective (5 EC)	Elective (5 EC)
Semester 3	Internship or Research Project (minimum 15 EC)		
Semester 4	Master project (maximum 45 EC)		

## Admission and enrolment procedure

The organization aims at an enrolment of 10-20 students per year. This program will be open for students with a BSc in all disciplines in (applied) sciences, including chemistry, physics, electrical and mechanical engineering, materials science and biology. Because of the anticipated background diversity of the group, emphasis in teaching will be on individual coaching. The Master program is research oriented and this asks for excellent students and therefore there will be a selection based on the BSc study results, motivation and (if possible) an interview. For the enrolment procedure you will have to provide the following documents:

- An application form fully completed. Go to the graduate site (<http://graduate.utwente.nl>)
- A curriculum vitae.
- If English is not your native language, a document stating you have a minimum score of 6.5 in an IELTS-test (International English Language Test). If your Bachelor was provided in English (please send a document to prove this), an exception can be made.
- A summary of BSc-courses in English, preferably with indication of books, etc.
- A certified copy of relevant diplomas, together with an English translation by a certified translator and a list of marks (can be delivered at a later stage of the procedure).



## Financial Situation

Students must be enrolled into the University of Twente graduate program. For Dutch students and students from other European Economic Area (EEA) countries the governmentally subsidized student fee of about € 1500,- per annual must be paid. Non-EEA residents have to pay the nonsubsidized fee of about € 8100,-

For international students who intend to continue their MSc studies with a (salary paid) PhD position the University of Twente offers a limited number of loans, that covers living expenses and tuition fee during the first 12 months. For students from EEA-countries there are possibilities via the general Dutch scholarship system. For further information please visit [www.ib-groep.nl](http://www.ib-groep.nl) and the link to international visitors.

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# Graduate.utwente.nl

## Further Information

For more information about the University of Twente and its graduate studies go to the website <http://graduate.utwente.nl>.

More specific information on the research of the different research groups involved in the Master can be obtained at <http://www.mesaplus.utwente.nl>.

For further information and application for the (international) master program you can contact the program coordinator international MSc program:

Ing. H.A. Akse. The address data are:

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