Curriculum description of

Master

Applied Nanotechnology

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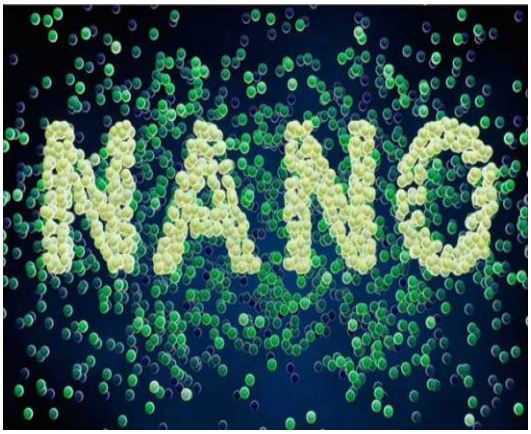
Content

1 Introduction



The distinguishing feature of the **2 years Master degree programme Applied Nanotechnology** is the design and development of innovative products and applications in the field of nano technology. As such, this Master degree programme is **unique in the Netherlands**. Nanotechnology, design, solving problems for diverse target groups, high-tech skills and knowledge of various disciplines are the themes that run throughout the programme. This Master degree programme is all about translating new theory into as-yet-unknown innovative real applications.

Nanotechnology in Twente

Twente is located in the east of the Netherlands, and has got 2 universities; **the research university of Twente** and the **university of applied sciences Saxion**.

Twente is the ultimate nanotechnologyhotspot in the Netherlands. The region boasts impressive facilities and know-how in this subject area.

The state-of-the-art Nano facilities of the world wide recognised research labs of MESA+ and MIRA, are shared with University of Twente and Saxion.

MESA+ INSTITUTE FOR NANOTECHNOLOGY

""MESA+ is one of the world's leading nanotechnology research institutes. Over 500 researchers focus on key enabling technologies – nanotechnology, photonics, micro- and nano-electronics, biomolecular and polymer science, advanced materials, lab-on-chip, microfluidics – and exciting new cross-overs. Benefiting from facilities that rank among the very best on the globe, our researchers deliver high-quality, competitive and frequently ground-breaking research.
""

MIRA BIOMEDICAL TECHNOLOGY AND TECHNICAL MEDICINE

""
Technological science is the catalyst for innovation in healthcare. MIRA combines fundamental and applied research with clinical practice. This unique scientific path stimulates a successful application of fundamental concepts and enables healthcare to rapidly introduce new treatments. MIRA works closely with hospitals, the business community and governmental organizations, aiming to secure its leading position in Europe.
""

Together, Saxion and the University of Twente offer a comprehensive range of programmes in the Nano technology. There are two Nanotechnology programmes at Master level:

- The University of Twente offers a Master degree programme Nanotechnology which focuses on **principal research**. Traditionally, most students transfer to a PhD trajectory at the university upon graduation.
- Saxion offers a Master degree programme with a focus on **applied nanotechnology**. This Master degree programme Applied Nanotechnology takes previously acquired knowledge and the outcomes of the type of research carried out at the university as its starting points and applies them to topical challenges or assignments, such as product development.

Nanotechnology research

Saxion's main area of research is formed by technology-related High Tech Systems and Materials (HTSM). These are converted into 'Living Technology' by turning technological breakthroughs and innovations into products and systems designed to advance society.
Once of Saxion's specialisations within this broad technology spectrum is nano- and microtechnology. The nano- and microtechnology research groups carry out applied research in the area of medical, biological and chemical applications (research group NanoBioInterface) or the area of systems and hardware (research group NanoPhysicsInterface). Their research is demand-driven.
They also co-operate closely with the business community. Business have indicated that they need help with the conversion of research outcomes into practical applications. This is the main strength of our higher education students: they turn research outcomes into products or concepts for businesses to use.
More information on Saxion's Nanotechnolgy research can be found on the website of Saxion's research group Nanotechnology

2 Saxion Master of Nano technology

What will you be learning?

During this programme, you will be applying your knowledge of micro- and nanotechnology in innovative ways. On the basis of micro- and nanotechnology principles, you will be developing products and processes which contribute to the resolution of societal challenges in a range of areas, such as energy, healthcare, sustainability or even forensic science. On completion of your Master degree programme, you will be well versed in creative thinking and operating at the cutting edge of innovative applied nanotechnology design. You come up with new solutions and build and test prototypes based on the challenges and wishes of the end user. By working closely with the professional field, you will gain important practical experience with high-tech manufacturing and design businesses. This will help you apply your knowledge. In addition, time will be spent on developing vital soft skills, e.g. communication, teamwork, ethics and entrepreneurship.

The nanotechn0loy curriculum is based on the competences of the Bachelor of Science Engineering profile (Bsc Engineering) with an new high competence level 4. This level 4 requires that the student can work successfully with

- Innovative products or methods using micro or nanotechnology
- New applications or markets using micro or nanotechnology
- Modifications of existing micro or nano products, applying them in an innovative r
  The figure below shows the specific level 4 competences.

- Analyse; selecting relevant aspects to the problem / influence on business social and technical environment / clearly define problem objective and task related to market potential uesers / setting up requeements / modelling a pilot setting or a real product
- Design; select and design a pilot concept solution / feasibility and testability of the design / selecting design tools
- Realise; using new or existing materials processes and methods / producing nano / micro components and complete products / verifying and validating the realised product
- Advise; listen and clarify to then need of the market and the nanotechnology suppliers / translating needs into viable solutions / adequate and convincing advise
- Professionalise; setting and implement learning objectives and strategies / flexible attitude in professional situations / sensitive for ethical dilemma's /constructive feedback and reflection.

Year one of the Master Applied Nanotechnology

- The first semester of the year is taken up by a foundation course. Both theory and practical training will be focused on teaching you various methods and techniques for developing (innovative) micro- and nanotechnology products and applications. Subjects in this first semester include physics, mathematics, physical chemistry and micro-/nanotechnology.
- In the second semester, you are assigned an individual project, leading to a report that you must then uphold. The projects are inspired by a variety of specialisations including microfluidics, bio-functionalised surfaces and interface electronics. Tutorials offer you the opportunity to lend more depth to your (theoretical) knowledge. During this first year, you also learn the basics of creative thinking, entrepreneurship and the ethics of technology.

Year two of the Master Applied Nanotechnology

- In the second year, you study a number of compulsory subjects including Introduction to Visualization and Simulation and Environmental Aspects of Nanotechnology and Nanotoxiology. Additionally, you pick a number of scientific or specialisation subjects. The major part of the second year is taken up by the final year assignment (thesis) on location. This may focus on a specialisation area, an early prototype or an end product. You are responsible for arranging your own final year assignment. Obviously, you can make full use of Saxion's existing network of contacts.

3 From Bachelor to Master, entry requirements and fee

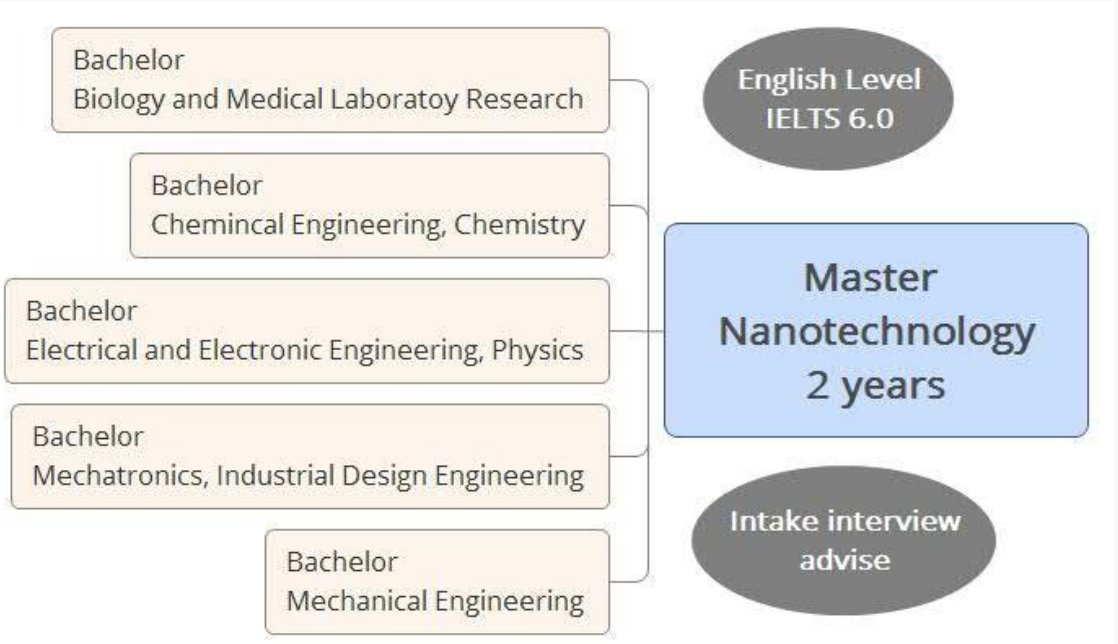
Requirements

Your admission is conditional on you holding a Bachelor degree in one of the following subjects

- Biology & Medical Laboratory Research
- Chemical Engineering
- Chemistry
- Electrical and Electronic Engineering
- Engineering Physics
- Mechatronics, Industrial Design Engineering
- Mechanical Engineering
- or a comparable subject.

- AND you can prove your English level on IELTS 6,5 or equal.

An intake interview (Skype or facetime) forms part of the admission procedure. You will receive an email invite for this. The intake interview will focus on the match between your background and expectations on the one hand and the programme on the other. The outcome of this interview is non-binding.



Tuition fee

Annual tuition fee: around € 8,900 for Non European (2017). Books: around € 750.
For an extensive overview of costs, please refer to www.saxion.edu.

4 Career positions

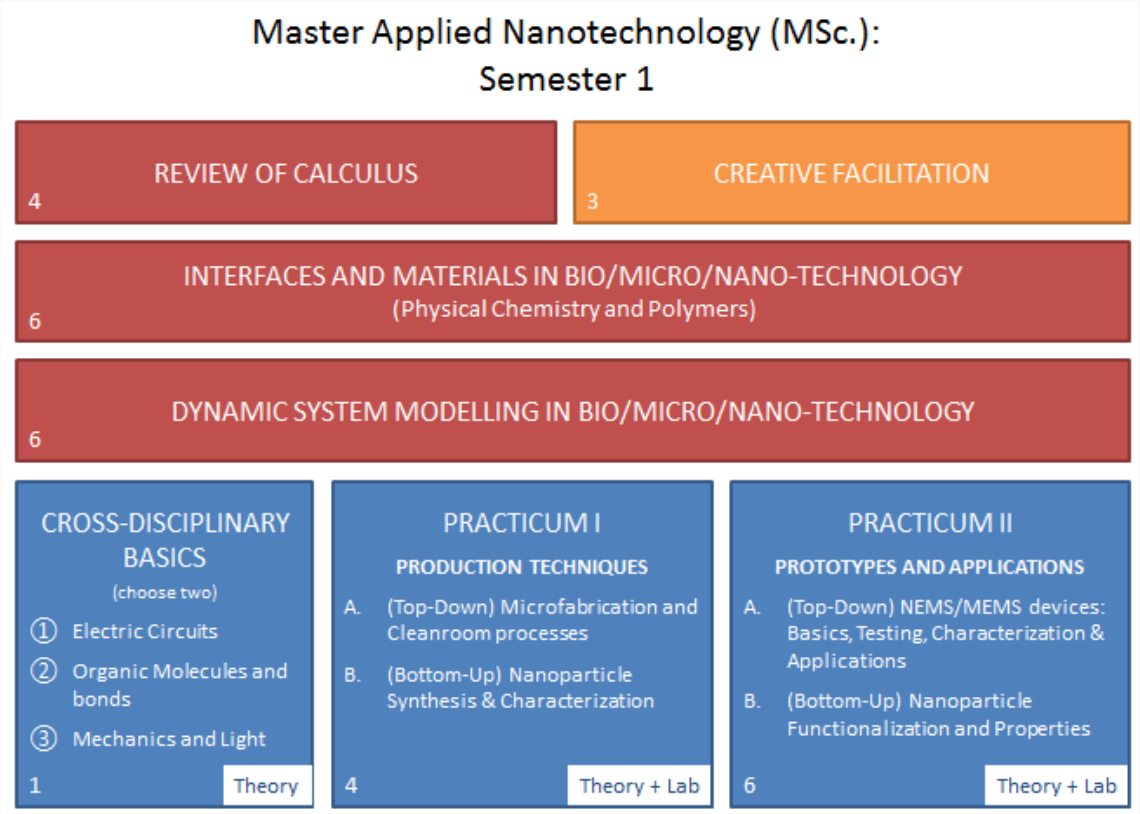
Nanotechnology generates ever more jobs in the Netherlands, particularly in the Eastern Netherlands. The Twente region has the highest concentration of high-tech businesses (almost 400) in the country. Working closely with the University of Twente, Saxion and active partners from the public sector, these businesses develop nanoscience and nanotechnology knowledge and apply it to design new products. Three or four new start-ups emerge in Twente every year.

As holder of a Master degree in Applied Nanotechnology, you will be able to find employment in a number of technical positions, such as product engineer, application engineer, project engineer or R&D engineer. You will be part of research and development teams for start-ups, crossovers and knowledge institutions. Here you will learn to develop new products and/or processes, conquer new markets, design new applications or modify and implement existing products and/or processes. Naturally, you may also be appointed to business-facing positions, where you will use your technical/development know-how to market innovative applications to clients and customise them to their wishes.
Upon graduation, you are entitled to use the title of Master of Science (post-nominal letters: MSc).

5 Course content overview

During the programme, you will always have access to the latest international knowledge and literature. The teaching materials are in English, which is also the language of instruction. The Master degree programme Applied Nanotechnology is offered jointly by Saxion and the University of Twente (UT). You will be using both Saxion's laboratory facilities in the High Tech Factory and the UT's own top-class facilities, such as the MESA+ NanoLab.

Year 1 semester 1



Review of calculus

Summary of the basic needs of calculus used in the master

Creative facilitation

Tools for design thinking to create innovative ideas and to choose the right ones.

Interfaces and materials in bio/micro/nano technology

Liquid Surfaces / Thermodynamics of Interfaces / Charged Interfaces and the Electric Double Layer / Surface Forces / Contact Angle Phenomena and Wetting / Solid Surfaces / Absorption / Surface Modification / Friction, Lubrication, and Wear / Surfactants, Micelles, Emulsions, and Foams / Modern Polymers / Polymer Mechanics and Rheology / Block Copolymers / Polymer Grafts / Stimuli Responsive Polymer Brushes

Dynamic system modelling in bio/micro/nano technology

Nomenclatures and the making of models / Mathematical tools is modelling dynamic systems / Compartmental models of Bio-Systems; Mass action and modelling of reaction kinetics / Kinetic modelling in MEMS (micro-electro-mechanical systems) / Identification of structures from data

Cross disciplinary basics

Additional courses, not belonging to your bachelor background to complete your knowledge.

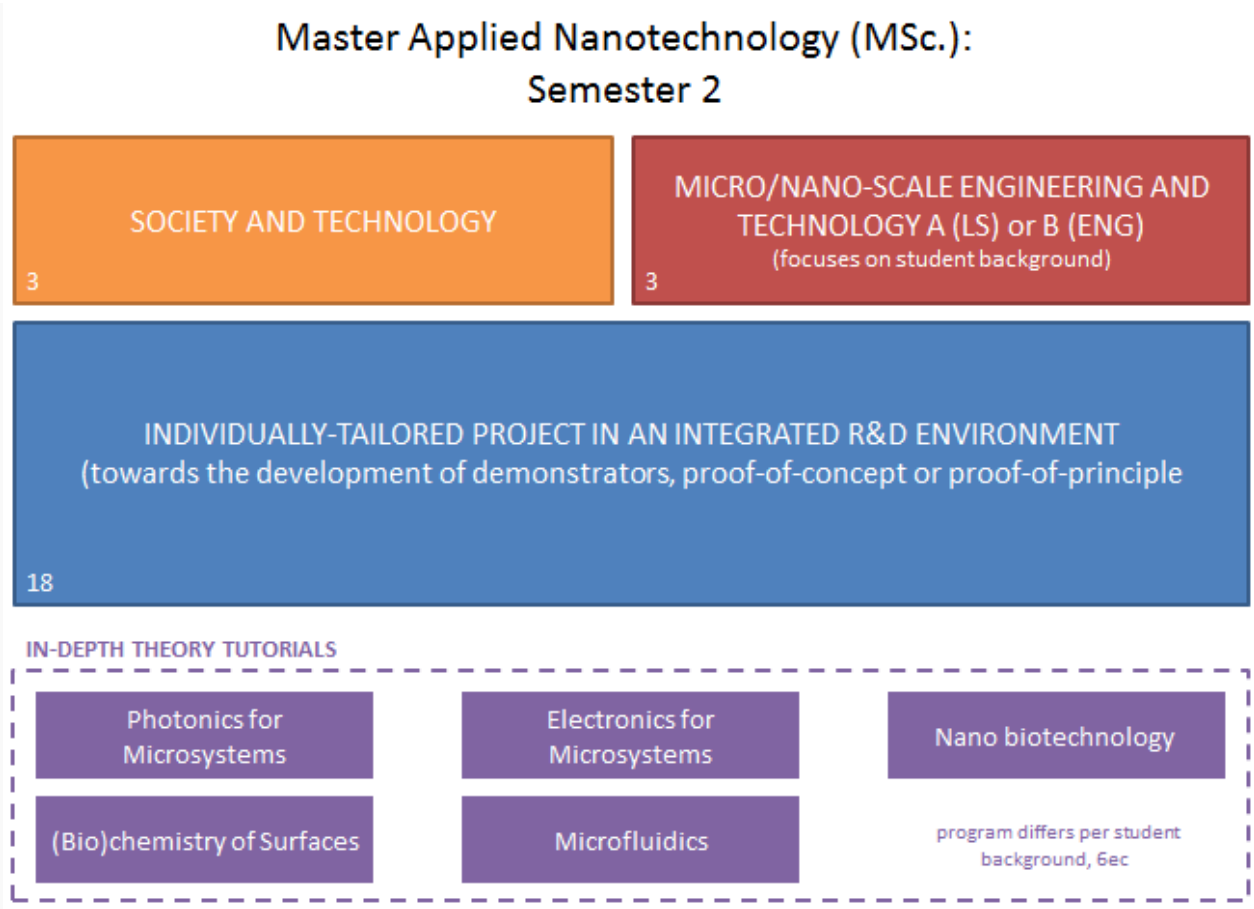
Practicum 1

Micro fabrication and Cleanroom Technology (workshop + lab)
Synthesis of gold nanorods and characterization (workshop + Lab)

Practicum 2

MEMS Devices (workshop + lab)
Dye sensitized solar cell, fabrication and characterization (workshop + lab)

Year 1 semester 2



Society and technology

Academic writing / ethics in relation to nano / micro technology

Micro/Nano-scale engineering and technology A (connected to the bachelor life science)

Synthesis and Modification of Nanomaterials /Bottom-Up Fabrication Methods / Supramolecular Chemistry / Nanobiotechnology / Biomimetics / Medical / Nanotechnology

Micro/Nano-scale engineering and technology B (connected to the bachelor engineering

Crystal structures / Electronic transport on micro/nano-scale (Nanoelectronics) / Magnetic properties of micro/nano structures / Graphene and cabron nanomaterials / Plasmonics

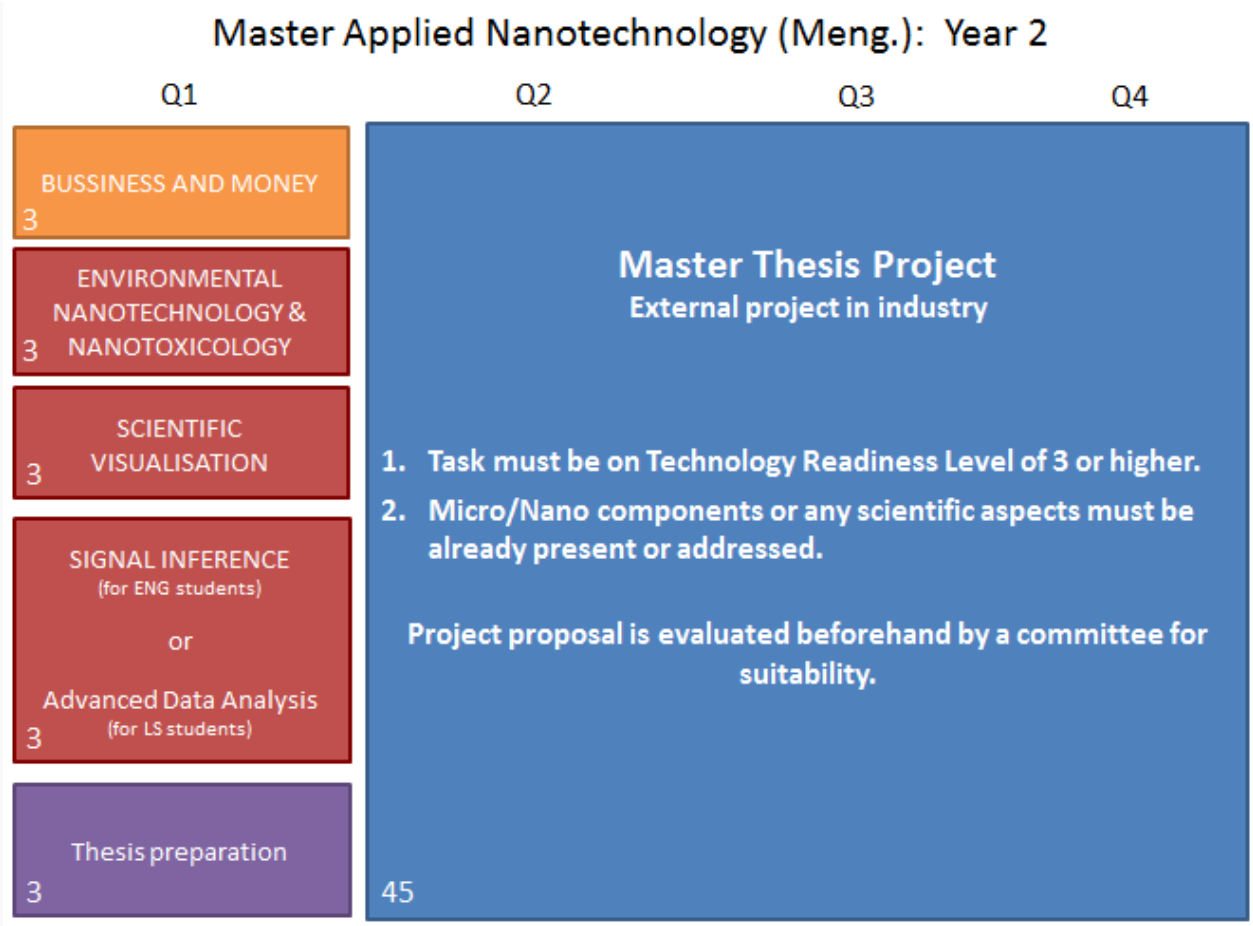
Individually tailored project in an integrated research and development environment

3 students multidisciplinary team with individual participation and specialisation.

2 Modules in depth of choice connected to the bachelor education

Photonics for microsystems / lectronics for microsystems / Nano biotechnology / Biochemistry of surfaces / Microfluidics

Year 2 semester 1 and 2



Business and money

Entrepreneurship / business plan/ investments and costs

Environmental nanotechnology and Nano toxicology

Toxicity of nano materials / procedures /software

Scientific visualization

Representing scientific data in 2d and 3d in a professional way.

Signal interference (connected to bachelor engineering)

Review of Signals & Systems Theory / Probabilistic models & random processes / Power Spectral Densities and signal estimation

Advanced data analysis (connected to bachelor life science)

Univariate data analysis / Graphical representations and Maps / Multivariate exploratory analysis / Reduction of dimensionality / Distances and clusters

Thesis preparation

Capia selecta in relation to thesis

Master thesis project

External project in industry