Nanotechnology

Faculty of Science & Technology,
University of Twente

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This report was finalized on 5 June 2014.

Report on the master's programme Nanotechnology of University of Twente

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point.

Administrative data regarding the programme

Master's programme Nanotechnology

Name of the programme:	Nanotechnology
CROHO number:	60028
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	none
Location(s):	Enschede
Mode(s) of study:	fulltime
Expiration of accreditation:	31-12-2014

The visit of the assessment committee Physics and Astronomy to the Faculty of Science and Technology of University of Twente took place on 18-19 March 2014.

Administrative data regarding the institution

Name of the institution:	University of Twente
Status of the institution:	publicly funded institute
Result institutional quality assurance assessment:	positive

Quantitative data regarding the programme

The required quantitative data regarding the programme are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the master's programme Nanotechnology consisted of:

- Prof. dr. Daan Lenstra, professor emeritus of Electrical Engineering at Delft University of Technology and fellow at Eindhoven University of Technology (chair);
- Prof. dr. Wim de Boer, professor of Physics at the University of Karlsruhe (DE);
- Prof. dr. Friso van der Veen, professor of Experimental Physics at ETH Zürich
- Christianne Vink MSc, didactic coach, educational advisor/trainer and partner of Academic Factory;
- Dr. ir. Harald Tepper, chief strategy officer at the Dutch Forensic Institute;
- Lisanne Coenen BSc, master student Applied Physics at Delft University of Technology;

Dr. J. Corporaal, who acted as secretary, supported the committee. She was supervised by Kees-Jan van Klaveren MA.

Appendix 1 contains the curricula vitae of the members of the committee.

Working method of the assessment committee

The assessment of the master's programme Nanotechnology of the University of Twente is part of a cluster assessment. In the context of this cluster visitation, in the time period between November 2013 and April 2014, twenty-eight programmes at nine different institutions were assessed.

Appendix 2 contains the framework of reference.

The committee Physics and Astronomy is composed of in total sixteen members:

- Prof. dr. Daan Lenstra, professor emeritus of Electrical Engineering at Delft University of Technology and fellow at Eindhoven University of Technology (chair);
- Prof. dr. Wim de Boer, professor of Physics at the University of Karlsruhe (DE);
- Prof. dr. Elias Brinks, professor of Astrophysics at the University of Hertfordshire (UK);
- Prof. dr. Tom Theuns, reader in Astrophysics at Durham University (UK) and part time professor of Astrophysics at University of Antwerp (BE);
- Prof. dr. Gustaaf Borghs, professor emeritus of Physics at KU Leuven (BE) and senior fellow at the Interuniversity MicroElectronics Centre (IMEC);
- Dr. ir. Jaap Flokstra, retired associate professor Nanotechnology at University of Twente;
- Prof. dr. ir. Guido van Oost, full professor Plasma Physics at the Department of Applied Physics of Ghent University (BE);
- Dr. Henk Blok, retired associate professor at the Faculty of Sciences of VU University Amsterdam;
- Prof. dr. Martin Goedhart, professor Mathematics and Science Education at University of Groningen;
- Christianne Vink MSc, didactic coach, educational advisor/trainer and partner of Academic Factory;
- Dr. Jan Hoogenraad, owner of Spoorgloren BV for change management and quantitative service in public transport;
- Dr. ir. Harald Tepper, chief strategy officer at the Dutch Forensic Institute;
- Sander Breur MSc, PhD candidate at Nikhef, University of Amsterdam;
- Lisanne Coenen BSc, master student Applied Physics at Delft University of Technology;
- Carmen van Schoubroeck, bachelor student Mathematics and bachelor student Physics and Astronomy, Radboud University Nijmegen;
- Jelmer Wagenaar MSc, PhD candidate in Physics at Leiden University.

Preparation
The committee held a preliminary meeting on October 8, 2013. During this meeting the committee was instructed about the accreditation framework and the programme of the

upcoming assessments. A vice chair for each visit was appointed and the Domain Specific Framework for Physics and Astronomy was set.

To prepare the contents of the site visits, the coordinator first checked the quality and completeness of the critical reflections prepared by the programmes. After establishing that the reports met the demands, they were forwarded to the participating committee members. The committee members read the reports and formulated questions on their contents.

Apart from the critical reflections, the committee members read a selection of fifteen theses. The theses were randomly chosen from a list of graduates of the last two completed academic years within a range of grades. Five theses with a stronger chemistry profile were also read by prof. dr. Ernst Sudhölter, professor Nano-Organic Chemistry at Delft University of Technology, who acted as external expert.

Site visit
A preliminary programme of the site visit was made by the coordinator and adapted after consultation of the chair of the committee and the contact persons at University of Twente. The timetable for the visit in Twente is included as Appendix 6.

Prior to the site visit, the committee asked the programmes to select representative interview partners. During the site visit, meetings were held with panels representing the faculty management, the programme management, alumni, the Programme Committee and the Board of Examiners. Meetings were also held with representatives of the students and teaching staff.

During the site visit, the committee examined material it had requested; an overview of this material is given in Appendix 7. The committee gave students and lecturers the opportunity – outside the set interviews – to speak informally to the committee during a consultation hour. No requests were received for this option.

The committee used the final part of the visit for an internal meeting to discuss the findings. The visit was concluded with a public oral presentation of the preliminary impressions and general observations by the chair of the committee.

Report
Based on the committee's findings, the secretary prepared a draft report. This report was presented to the committee members involved in the site visit. After receiving approval, the draft report was sent to the Faculty with the request to check it for factual inaccuracies. The comments received from the Faculty were discussed with the committee chairman. Subsequently, the definitive report was approved and sent to the University of Twente.

Decision rules
In accordance with the NVAO's Assessment Framework for Limited Programme Assessments (as of 22 November 2011), the committee used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

Summary judgement

This report reflects the findings and considerations of the committee on the master's programme in Nanotechnology of the University of Twente. The judgment of the committee is based on information provided in the critical reflection and the selected theses, additional documentation and interviews conducted during the site visit. The committee noted both positive aspects and aspects which could be improved. Taking those aspects into consideration, the committee concludes that the master's programme Nanotechnology of University of Twente fulfils the requirements of the criteria set by NVAO which are the conditions for accreditation.

Standard 1 Intended learning outcomes
The master's degree programme Nanotechnology is situated in the Faculty of Science & Technology. It is one of 36 master's programmes offered by the University of Twente. The programme has formulated its mission statement as: 'to educate students at an internationally renowned master's level to become proactive researchers, designers and engineers who are capable of developing, conveying and applying innovative knowledge according to academic standards in nanotechnology'. The programme does not have separate tracks.

The programme is aimed at (international) students with a background in advanced technology, applied physics, chemical engineering, electrical engineering, or other relevant disciplines. It has a strong research-focus and is closely connected to two research institutes of the University of Twente: MESA+ Institute for Nanotechnology and MIRA Institute for Biomedical Technology and Technical Medicine.

The committee has discussed the profile, level and orientation of the programme. It sees a well-structured, truly multidisciplinary master's programme with much attention for individual students' progress.

The committee has studied the intended learning outcomes. It concludes that they are in line with the domain specific framework of reference and with the ACQA-criteria formulated by the three Dutch technical universities (3TU). The learning outcomes are in line with what may be expected from an academic master's programme from an international perspective. The outcomes distinctly surpass the level of a bachelor's programme.

Standard 2 Teaching – learning environment
The master's degree programme Nanotechnology consists of 120 EC, evenly divided over two years. Each year is further divided in four blocks of approximately ten weeks each, allowing students to follow at most two theoretical courses next to each other. The first year of the master's programme focuses on acquiring the necessary knowledge basis and laboratory skills, the second year is devoted completely to research.

The committee has studied the programme and the course descriptions. It concludes that the content and design of the master's programme Nanotechnology ensure that students are able to achieve the intended learning outcomes. The programme succeeds in offering a varied and challenging set of courses, reflecting the focus areas of research institutes MESA+ and (to a lesser extent) MIRA. The committee is aware of the fact that the range and the level of the courses are very much determined by the research groups that participate in the programme. The presence of internationally renowned research groups ensures that students are able to benefit from excellent research expertise. In this respect, the committee is also enthusiastic about the fact that students can participate in activities organized by MESA+, such as the

Workshop Fundamentals of Nanotechnology, the MESA+ colloquia and the Annual Meeting.

The committee concludes that the scientific orientation of the programme is more than sufficiently safeguarded by the direct links with the two research institutes. The research-focus of the programme is clearly reflected in the curriculum. The students seem to appreciate this research-focus. The student representatives with whom the committee spoke, were all hoping to continue their education in a PhD-trajectory.

The committee strongly advises the programme management to pay more attention to professional orientation outside research. Especially given its technological profile, the programme should pay more attention to the full breadth of career opportunities in industry. The programme management is planning to set up a committee covering the professional field with alumni from the programme. The committee urges the programme management to carry out this plan at short notice.

The committee concludes that students highly appreciate the flexibility the programme gives them. This flexibility makes it possible to pursue personal interests while crossing boundaries between disciplines. Students eventually specialize in one subfield of nanotechnology. There is a clear connection between the aims of the courses and the learning aims of the programme.

In a programme such as nanotechnology, the committee considers ethics an important subject in general. In this respect, the committee is enthusiastic about the course 'Societal embedding of Nanotechnology', which among others deals with the ethical implications of research in the area of nanotechnology.

The didactic concept of the programme, the committee finds, is not very transparent at the moment and asks for a better elaboration. The programme presently is discussing which aspects they would possibly like to adopt from the new Twents Onderwijs Model (TOM), introduced in all bachelor's programmes. The committee advises the programme to first get a clear picture of the learning environment it wants to create (in alignment with the intended learning outcomes), before reconsidering the teaching formats.

Even though the number of students is steadily rising, the average intake is still too low. The assessment committee has formulated suggestions to increase this number. The committee is pleased to hear that students generally feel well supported during their studies. The committee observed that there is a good system of study guidance in place, distinguishing between different students with different needs. Study progress is closely monitored and hardly any students leave the programme early. Although completion rates are very good, the committee advises the programme to dispel possible hurdles hampering study progress such as schedule problems and overlap between courses offered by different faculties. In the opinion of the committee, the programme management must work hard to resolve these problems. Tight connections between the faculties are also of paramount importance to fine-tune the learning outcomes of the courses to the learning outcomes of the programme.

The committee is impressed with the academic staff delivering the programme. The number of lecturers who obtained a teaching qualification (at present: 48%) leaves room for improvement. Teaching qualifications show that the programme takes the quality of teaching seriously. On the other hand, the teaching and research facilities are excellent.

The committee has assessed to what extent students and graduates are involved in the evaluation of the programmes. Students are frequently asked to evaluate the programme, not only at course level, but also at the level of the curriculum. The committee suggests that the programme could expand their 3-tier system of quality control with a fourth one by including alumni. The committee expects that contacts with alumni once they have started their professional career will lead to identifying potential stumbling blocks in the composition of the programme and to formulating improvement measurements.

The assessment committee concludes that the Programme Committee takes an adequate role in the process of quality assurance, but is not fully representative. The assessment committee urges the Committee to appoint at least one international student member.

Standard 3 Assessment and achieved learning outcomes
The committee finds the assessment procedure adequate. Students are well informed about assessment procedures and they appreciate the various assessment techniques. Assessment forms in the master's programme match the learning aims of the courses and those of the programmes. The committee considered exams in the master's programme to be of a high standard. It was also content with the fact that for each exam there are test matrices available containing, for instance, model answers.

The committee is happy to hear that the Board of Examiners plans to implement policy on detecting fraud and/or plagiarism.

The introduction of a new assessment form for the assessment of the master's research project in September 2011 has led to more clarity on what the final grades are based on. The committee was very impressed with this assessment form, which makes a clear distinction between 31 aspects which are taken into consideration when grading both the scientific and the general academic character of the research project, the report and the oral presentation. The committee would find it desirable if members of Master Assignment Committee filled in their assessment forms individually before reaching a consensus about the final grades, so as to ensure an independent judgment of all members.

To assess the level achieved by the students, the committee examined a range of master's theses. Based on the master theses the committee has studied and the extra session with the examiners, it concludes that the theses match the level that may be expected of a graduate of an academic master's degree programme in nanotechnology.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Standard 1: Intended learning outcomes	**satisfactory**
Standard 2: Teaching-learning environment	**satisfactory**
Standard 3: Assessment and achieved learning outcomes	**satisfactory**
General conclusion	**satisfactory**

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 5 June 2014.

Prof. dr. Daan Lenstra

dr. Joke Corporaal

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

In this paragraph the findings of the committee with regard to the Domain Specific Framework of Reference and intended learning outcomes, the level and orientation of the programme are described. After considering the findings the committee comes to a conclusion on Standard 1.

1.1 Profile

The master's degree programme Nanotechnology started in 2003. It is one of 36 master's programmes offered by the University of Twente. Together with four other master's programmes, the programme is situated in the Faculty of Science & Technology. The programme has formulated its mission statement as: 'to educate students at an internationally renowned master's level to become proactive researchers, designers and engineers who are capable of developing, conveying and applying innovative knowledge according to academic standards in nanotechnology'. Since nanotechnology as a research area combines insights from physics, chemistry and biology, the programme is aimed at (international) students with a background in advanced technology, applied physics, chemical engineering, electrical engineering, or other relevant disciplines. In the critical reflection, the programme describes that it focuses on 'the design, creation and study of functional materials, structures, devices and systems by directly controlling (i.e. characterizing and manipulating) matter on the nanometer scale.'

To further define it main goals, the programme lists 4 main objectives:

1. development of knowledge, skills and understanding in the field of nanotechnology
2. in-depth specialization of a subject in nanotechnology
3. development of professional, autonomous practice in nanotechnology or related fields
4. preparation for continuation in scientific research, process design and product development or professional training.

The programme is closely connected to research institute MESA+, which unites over 500 researchers in 36 research groups in the area of nanotechnology. For the most part, the master's degree programme Nanotechnology has based the topics of the curriculum (design, creation and study of functional materials, devices and systems) on the research topics of MESA+, and, to a lesser extent, to those of research institute MIRA (Biomedical Technology and Technical Medicine).

The programme positions itself on a national scale between similar master's programmes offered by Delft University of Technology and the University of Groningen. The programme at Twente is supposed to have a more technological character compared to the other programmes. At an international scale, the programme points at similar programmes in Denmark, Switzerland, Poland, Belgium and Spain. An appendix in the critical reflection shows how the structure of the master's programme Nanotechnology relates to the structure of these national and international programmes. The programme participates in two European Networks of Excellence ('Nano2Life' and 'Frontiers') and in an initiative set up by the British 'Institute of Nanotechnology' (International NanoMasters Course Directory and Recognition Scheme). Finally, the programme is planning to offer a double-degree master's programme together with the University of Lodz in Poland. After completing their bachelor's programme (3.5 years) in Poland, students would spend one year at the University of Twente and another year at the University of Lodz. The double-degree programme is supposed to start in September 2014.

The programme has a strong research focus, which is reflected in the fact that 70% of graduates continue their education in a PhD-trajectory. Although the programme covers different sub-areas of research, there are no official specialization tracks within the programme.

The committee has discussed the profile of the programme. It sees a well-set up, truly multidisciplinary master's programme with much attention for individual students' progress. The committee understands that it is problematic that this programme attracts few students. In this context, it supports programme management in its intentions to develop a double-degree programme in cooperation with the University of Lodz. The subject of the low intake came up in most meetings. The programme management asked the committee to formulate possible measures to increase the number of enrolling students.

According to the committee, the programme management could:

- Put more emphasis in its advertisement strategy (website, et cetera) on the close collaboration with research institute MESA+ and the fact that this programme offers in house education and training within this respected and internationally renowned research institute.
- More actively promote the master's programme to bachelor's students from relevant disciplines, within and outside the University of Twente, such as Saxion Hogeschool and the UT bachelor's programmes Applied Physics and Advanced Technology. This last programme attracts around 70 students per year and has seen an influx of enrolling students over the last years. The programme management is already planning to offer a separate module Nanotechnology in this bachelor's programme. Offer an exemplary digital course Nanotechnology on the programme's website. Not only can this attract (international) students, it may also cause them to reflect better on the level and contents of the programme.
- Pay more attention to the fact that this is an international master taught entirely in English. The commmittee learned that students from India for example do not automatically consider The Netherlands and Germany as countries that offer academic programmes in English.
- Be more specific in the advertisement strategy about the multidisciplinarity of the programme. The committee suggests that the programme could illustrate this with concrete examples of, for instance, the value of chemistry in the research area of Nanotechnology.
- The graduates, finally, were of the opinion that PR in general could be put to a much better use.

1.2 Orientation and intended learning outcomes

The master's programme Nanotechnology has based its learning outcomes on the 16 learning aims of the national reference framework (VSNU, 2002) and the criteria that the three technical universities (3TU) have agreed on in 2005 as the so-called ACQA-criteria (Academic Competences and Quality Assurance). Both frameworks distinguish between two kinds of skills: discipline specific knowledge and skills, and generic academic skills. In addition, the ACQA-criteria describe seven areas of competence in which students much acquire skills: discipline, research, design, scientific approach, intellectual skills, co-operating skills & context.

The master's programme Nanotechnology has formulated seven general aims based on the seven ACQA-areas of competence. The intended learning outcomes are listed in appendix 3. General learning outcomes are further divided into anywhere between five and nine specific aims. For instance, the general aim that graduates should be 'competent in cooperating and communicating' (aim 5) is further specified in six aims. The research focus of the programmes is reflected in most learning aims, principally in learning outcomes 2 ('has the knowledge and the skills for doing research in a specific field of nanotechnology') and 4 ('has a scientific approach') and their respective sub-aims.

Three matrices provided in different places in the critical reflection show what the relations are between (1) the 16 exit qualifications of the national reference framework and the 4 main objectives of the programme, (2) the 16 exit qualifications of the national reference framework and the ACQA-criteria, and (3) these ACQA-criteria and the courses provided in the programme. The committee has studied the intended learning outcomes. It concludes that these learning outcomes are formulated with great breadth and a lot of attention for details, by specifying which specific research, design and communication skills MSc graduates should possess. The intended learning outcomes are geared towards starting a professional career in the research area of nanotechnology. The committee concludes that the intended learning outcomes are in line with the domain specific framework of reference and with the ACQA-criteria formulated by the three Dutch technical universities.

The committee appreciates the attention the programme has paid to carefully formulating its intended learning outcomes. Although several learning outcomes describe generic skills that may be useful for a career outside academia, the committee advises the programme to adopt a specific learning outcome on job orientation

Considerations

The committee has discussed the profile, level and orientation of the programme. It sees a well-set up, truly multidisciplinary master's programme with a lot of attention for individual students' progress. The programme distinctly surpasses the level of a bachelor's programme – the programme focuses on specialization in one area of nanotechnology, as well as on students working increasingly more independent.

The committee concludes that the intended learning outcomes are in line with the domain specific framework of reference and with the ACQA-criteria formulated by the 3 technical universities. They are geared towards starting a professional career in the research area of nanotechnology and they are in line with what may be expected from an academic master's programme from an international perspective.

Conclusion

Master's programme Nanotechnology: the committee assesses Standard 1 as 'satisfactory'.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

The committee has studied the curricula of the programme, has seen the course material, the digital learning environment and results of course evaluations. In this standard the findings of the committee concerning the content, orientation and structure of the programmes (2.1), intake and study load (2.2) teaching staff (2.3) facilities and system of internal quality assurance (2.4) are discussed.

2.1 Contents, structure and orientation of the programme

The master's degree programme Nanotechnology consists of 120 EC, evenly divided over two years. Each year is further divided in four blockw of approximately ten weeks each, allowing students to follow at most two theoretical courses next to each other. An overview of the curriculum can be found in appendix 4. The first year of the master's programme focuses on acquiring the necessary knowledge basis and laboratory skills, the second year is devoted completely to research. Two faculties provide the courses: the Faculty of Science and Technology and the Faculty of Electric Engineering, Mathematics and Computer Science, EEMCS.

The first year of the master's programme comprises eight compulsory courses (together 30 EC) and 30 EC elective courses. Compulsory courses are: (1) 'Fabrication of nanostructures', (2) 'Characterization of nanostructures', (3) 'Nanoscience' and (4) 'Laboratory course' (each 5 EC), (5) 'Cleanroom course' (2 EC), (6) 'Paper and presentation' (3 EC), and (7) Societal embedding of nanotechnology' and 'Technology venturing' (both 2.5 EC). Half of the elective courses in the first year must be chosen from 6 nanotechnology elective courses (for instance 'Nano-optics' or 'Nanomedicine'), each accounting for 5 EC. There is no set rule as to in which order courses must be taken, so that students can also start the programme in February. Most students start the programme with the first three compulsory courses before they start the practical courses (4) and (5). Each course is concluded with a written exam or with a report, oral presentation or practical assignment. A description of the assessment policies is given in Standard 3.

The second year of the programme consists of a three-month internship (15 EC) and a research project (45 EC). Dutch students must perform their internship outside the University of Twente, preferably abroad, international students may choose between an internship outside the University of Twente or a 15 EC research project in one of the research groups. The internship/research project (15 EC) is concluded with a written report.

Students carry out their master research project within one of the research groups of MESA+ or MIRA. Before starting the assignment, students fill in a master thesis contract, containing a project description and a work plan, as well as an explanation of the nanotechnology character of the project. The Board of Examiners must approve of the master thesis contract to ensure that the research project ties in well with the rest of the programme. Also, students must at least have obtained 50 EC from the first year before they are allowed to start the master assignment. In the research project, students learn to independently formulate a research question and make a time schedule, execute experiments, analyze and interpret the acquired data, and draw conclusions in a written report, within a framework of related published work. This MSc thesis is subsequently defended in front of a committee.

The didactic concept underlying the master's programme is that of 'a more self-directed and autonomous manner of study' compared with a bachelor's programme. Students have more freedom to set their own study path and attend fewer lectures. Research skills are practiced in the Laboratory Course (5 EC) and the research project (45 EC) at the end of the programme. In the critical reflection, the programme show that there is a core group of 14 research groups where most students decide to carry out their research. 12 of those are part of research institute MESA+, 1 is linked with the MIRA institute and 1 is linked with both institutes.

The committee strongly advises the programme management to pay more attention to professional orientation outside research. Although a majority of graduates pursue an academic career, still almost one in four students opts for a career in industy. The committee thinks the programme has a responsibility to inform those students about their opportunities outside research. Programme management indicated it is planning to set up a working field committee with graduates from the programme. The committee urges programme management to carry out this plan at short notice.

Although the committee appreciates the attention the programme has paid to carefully formulating its intended learning outcomes, it also notes that some of these outcomes recur much more implicitly in the curriculum of the programme. Learning outcome 6f for instance states that graduates must be able to adopt a leadership (managerial) role in a team. The committee could not pinpoint during which part(s) of the curriculum students would acquire the skills to do so. It advises the programme to ensure that all learning outcomes are explicitly translated into the curriculum.

2.2 Intake, study load and study guidance

The master's programme Nanotechnology has laid down its admission requirements in the Course and Examination Regulations (OER). Direct access is granted to students who have successfully completed a bachelor's degree in Applied Physics, Chemical Engineering or Electrical Engineering at a Dutch university. For the remaining three groups of applicants, different requirements apply:

1. Students from the bachelor's degree programme Advanced Technology need to take five selected courses (27.5 EC) preparing them for the master's programme Nanotechnology during their bachelor's programme.
2. Students with a professional (HBO) bachelor's degree in Applied Physics, Chemical Technology, Chemistry or Electrical Engineering have to follow a pre-master programme (6 courses, 30 EC) before they can enter the programme. Instead of an internship, they follow additional courses (15 EC). The Board of Examiners decides upon the contents of the pre-master and the additional courses.
3. International students are individually assessed by an admission committee, consisting of the programme director, the programme coordinator and the coordinator internalization. International students must have previously acquired a cumulative grade point average of at least 7.5 and submit prove of sufficient English language proficiency.

For the period 2003-2013, the average number of students enrolling in the programme per year is 7. For the period 2008-2013, this number is 9.2. The last years show a steady intake of approximately 10 students a year (8 in 2011/2012, 14 in 2012/2013 and 10 in 2013/2014). Around 60% of students comes from abroad. Since 2007, there is a steady influx of students from the bachelor's programme Advanced Technology, which does not have a directly connecting master's programme. As discussed in standard 1, the committee agrees with programme management that this intake should improve and has formulated several suggestions that might help to do so.

As stated before, the curriculum of the two-year master's programme Nanotechnology is divided in four blocks a year of approximately ten weeks each. There is no set order in which courses must be taken, but students usually follow no more than two theoretical courses next to each other, which ensures an even spread of the study load. The internship and the MSc assignment take up respectively one and three blocks in the second year of the master's programme. The weekly amount of contact hours is estimated at 14.5 for the first year of the programme. In the second year, students are more intensely supervised during their internship and research project.

During the site visit, the committee spoke with student representatives of the master's programme about the study load and the feasibility of the programme. The students were of the opinion that the programme in its current form is challenging, but doable. The international students mentioned that there are differences between the educational systems in their home countries and the educational system in The Netherlands. The latter asks for a more autonomous study attitude. The students highly appreciate the flexibility the programme offers them, allowing them to focus on their interests, and the infrastructure and facilities that are provided ('the biggest clean rooms of Europe!'). The students were also enthusiastic about the combination of practical and theoretical components in the curriculum. One course in particular was mentioned as very good in this respect: 'Societal embedding of nanotechnology.' The students also made three critical remarks concerning the feasibility and study load of the programme. Firstly, they conclude that in comparison with theoretical skills, practical skills are underrepresented in the programme. Secondly, they found that courses are not always planned well throughout the year. This is due to the fact that the courses are provided by two faculties (the Faculty of Science and Technology and the Faculty of Electric Engineering, Mathematics and Computer Science, EEMCS). The coordination between the two faculties, the students observe, could be better. To conclude, students mentioned that some courses show a considerable amount of overlap. 'Nanoscience', 'Nanoelectronics' and 'Nanophysics' (the first a compulsory course, the second two both elective courses, all accounting for 5 EC) were estimated to have 30% overlap.

When confronted with these bottle necks in the programme, the lecturers and programme management said that they are aware of the problems and that they are already working on it. They say that some of the initial courses function as homologation modules. As a consequence, students with a broader of deeper pre-existing knowledge will experience overlap. However, with such a wide variety of influx, a certain amount of repetition is unavoidable. In practice, students with a background in physics may experience difficulty with chemistry courses, and vice versa. Also, even though students claim there is too much repetition, the lecturers note that repetition can also be of help for the student, in that it aids them to better 'digest' the content.

For study guidance and tutoring, students can contact their mentor, the programme coordinator or the study advisor. From the information provided in the critical reflection and from talking to the programme management and students, the committee concludes that the programme has a very good system of study guidance in place. Individual students' progress is continuously monitored and different groups of students (for instance, students from abroad or from professional universities) are assigned to different tutors. Hardly any student quits the programme, and completion rates are very good; master's students take on average 2.1 year to graduate.

2.3 Academic staff

The academic staff that delivers the master's programme consists of 28 lecturers. Around 150 PhD-students and post-docs employed by MESA+ and MIRA also regularly assist in the teaching process, especially in the supervision of students during the Laboratory Course or the MSc assignment. Of the core staff, all lecturers except 5 have a PhD-degree and participate in scientific research. 8 lecturers hold a position as full professor. The student-staff ratio in estimated at 1:14.4.

36% of the academic staff (9 lecturers) have obtained the *Basis Kwalificatie Onderwijs* (BKO-certificate). 12% (3 lecturers) have acquired a similar degree. 24% (6 lecturers) have started the training, whereas 12% still has to start and another 16% (4 lecturers) are granted exemption. The committee notes that the number of teachers with a teaching qualification (48%, in the not too distant future 60%) could be improved. The committee insists that the programme management puts teaching professionalization higher on the agenda.

The committee is pleased to hear that the master's students are very enthusiastic about the expertise and teaching quality of their lecturers. The graduates said that the informal atmosphere and the friendliness of the staff had stimulated them to reach their maximum potential.

The committee concludes that the academic staff is sufficiently equipped for delivering the programmes.

2.4 Facilities and internal quality assurance

The bachelor's and master's degree programmes share facilities provided by the faculty of Science & Technology. The programme recently moved into a new building (Carré, Drienerlolaan 5), where MESA+ is also housed. Besides in Carré, research groups are accommodated in the buildings Zuidhorst and Meander. During the site visit, the assessment committee was offered a tour around the teaching facilities and the research facilities provided by MESA+. The committee concludes that the research facilities, in particular the 1.250 m^2 clean room, are excellent and ensure that students can profit from modern and state-of-the-art technology. Students who have reached the research project phase get a workplace in or nearby the laboratory or research group in which they carry out their master's assignment. They are treated as members of the research group and participate in all group activities. The committee is enthusiastic about this procedure.

The committee has assessed to what extent students and graduates are involved in the shaping and evaluation of the programmes. The critical reflection explains that the circle of quality assurance consists of three feedback loops:

- course and block evaluations (after each block)
- curriculum evaluation (midterm)
- institutional evaluation (long-term)

For course evaluations, evaluations forms are used. By stressing the importance of course evaluations, the response rate has gone up to 80-90%. The curriculum evaluation is carried out by means of a panel discussion, organized once per semester. 80-90% of students attend this panel discussion.

The committee learned that the programme does not keep in touch with alumni in a systematic way. The committee suggests that after graduating, students could be asked to evaluate the programme as a whole. The committee expects that such evaluations will lead to identifying potential stumbling block in the composition of the programme and to aid in formulating improvement measurements.

During the site visit, the assessment committee had a meeting with the Programme Committee, in which 2 members of staff and 2 students (one for each year of the programme) are represented. Student members are approached by the programme coordinator and the chair of the Committee. The Programme Committee favors Dutch speaking students, so that that the meetings and documentation can be in Dutch. The Programme Committee meets four or five times a year. The programme director is usually present at these meetings. The Programme Committee described its task as: guarding the system of quality control, both on the level of the programme and its individual courses.

The assessment committee was surprised to learn that the Programme Committee meetings are in Dutch, which effectively excludes international students (over 40% of students in the programme) from participating in the Programme Committee. When selecting new students, the assessment committee urges the Committee to at least include one international student member. Also, the committee asks the Programme Committee to reconsider whether it really is desirable for its independence that the programme director is present at every meeting.

The assessment committee asked the Programme Committee which main issues it is currently dealing with. The most important subject the Committee discusses is how to increase the number of students starting the programme. It regularly advises the programme management about this topic. Most of the time of the Education Committee is taken up by course evaluations. The Committee discusses the results and communicates those to the programme director. The Programme Committee is aware of the problem of the overlap between different compulsory and elective courses. Partly, the Committee believes, this is the result of courses being offered by different faculties.

Considerations

The committee has studied the programme and the course descriptions. It concludes that the content and design of the master's programme Nanotechnology ensure that students are able to achieve the intended learning outcomes. The programme succeeds in offering a varied and challenging set of courses, reflecting the focus areas of research institutes MESA+ and (to a lesser extent) MIRA. The committee is aware of the fact that the range and the level of the courses are very much determined by the research groups that participate in the programme. The presence of internationally renowned research groups ensures that students are able to benefit from excellent research expertise. In this respect, the committee is also enthusiastic about the possibility for students to participate in activities organized by MESA+, such as the Workshop Fundamentals of Nanotechnology, the MESA+ colloquia and the Annual Meeting.

The committee concludes that the scientific orientation of the programme is more than sufficiently safeguarded by the direct links with the two research institutes. The research-focus of the programme is clearly reflected in the curriculum. The students seem to appreciate this research-focus. The students with whom the committee spoke, were all hoping to continue their education in a PhD-trajectory.

The committee strongly advises the programme management to pay more attention to professional orientation outside research. The programme management is already planning to set up a working field committee with graduates from the programme. The committee urges the programme management to carry out this plan at short notice.

From talking to the students, the committee concludes that students highly appreciate the flexibility the programme gives them. This flexibility makes it possible to pursue personal interests while crossing boundaries between disciplines. Students eventually specialize in one subfield of nanotechnology. There is a clear connection between the aims of the courses and the learning aims of the programme. In general, the committee considers ethics an important subject. In this respect, the committee is enthusiastic about the course 'Societal embedding of Nanotechnology', which also deals with the ethical implications of research in the area of nanotechnology.

The didactic concept of the programme, the committee finds, is at the moment not very transparent and asks for a better elaboration. The programme presently is discussing which aspects they would possibly like to adopt from the new Twents Onderwijs Model (TOM), introduced in all bachelor's programmes. The programme explained during the assessment visit, that for instance problem-based learning might help international students entering the master's programme to acquire a similar level sooner. The committee advises the programme to first get a clear picture of the learning environment that they want to create, by considering which teaching formats are in alignment with the intended learning outcomes.

The average intake of students is low and should improve. The assessment committee has formulated strategies to increase this number. The committee is pleased to hear that students generally feel well supported during their studies. The committee observed that there is a good system of study guidance in place, distinguishing between different students with different needs. Study progress is closely monitored and hardly any students leave the programme early. Although completion rates are very good, the committee advises the programme to dispel possible hurdles hampering study progress such as schedule problems and overlap between courses offered by different faculties. In the opinion of the committee, the programme management must work hard to resolve these problems. Tight connections between the faculties are also of paramount importance to fine-tune the goals of the courses and the learning aims of the programme.

The committee is very impressed with the academic staff delivering the programme. The amount of lectures in the possession of a teaching qualification (at present: 48%) leaves room for improvement. On the other hand, the teaching and research facilities are excellent.

The committee has assessed to what extent students and graduates are involved in the shaping and evaluation of the programmes. Students are frequently asked to evaluate the programme, not only at course level, but also at the level of the curriculum. The committee suggests that the programme should expand their 3-tier system of quality control by including graduates. The committee expects that contacts with graduates once they have started their professional career will lead to identifying potential stumbling block in the composition of the programme and to formulating improvement measurements.

The assessment committee concludes that the Programme Committee adopts a pro-active role in the process of quality control. Due to practical reasons, international students are not included in this Programme Committee. The committee urges the Committee to incorporate at least one international student member.

Conclusion

Master's programme Nanotechnology: the committee assesses Standard 2 as 'satisfactory'.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

This section deals with the assessment policy, the procedures regarding testing and examination and the assessment methods of the programme. To this end various assessment materials have been evaluated, such as students' exams and essays, assessment keys and assessment forms. To assess whether graduates have obtained the intended learning outcomes, the committee studied a selection of fifteen master's theses; for five of those with a strong focus on chemistry, it consulted an external expert (as detailed above under 'working method'). It talked to alumni about the qualifications of the graduates and the relation to the requirements of the job market. Finally, the assessments and assessment system were discussed with students, the staff, the Board of Examiners and the programme management. 3.1 Deals with the assessment system and the Board of Examiners, 3.2. focuses on the academic level achieved.

3.1 Assessment system and Board of Examiners

In accordance with statutory regulations, the master's degree programme Nanotechnology has laid down its assessment system in an 'Education and Examination Regulations' (OER) document. The document provides students with information on, for instance, the admission criteria for tests, exam dates and assessment forms. The individual assessment procedure for each course is made clear at the beginning of that course and can be found in the course description. The Board of Examiners is responsible for drawing up and enforcing the rules and regulations, and for checking the quality of testing and assessment within the programme.

The programme makes use of various assessment forms. Most courses are concluded with a final written exam at the end of the course, but oral presentations and writing assignments are also used, as well as practical training with individual and group assignment, project reports and poster presentations. The committee has seen course exams and judges that they were of a high level. The committee was also happy with the assessment plans provided for each course. It concludes that the various assessment forms tie in well with the intended learning outcomes. Furthermore, it learned that students were positive about the assement policy. According to them, the various assessment techniques are well balanced.

The Board of Examiners described its task as: 'to determine whether students have acquired the final qualifications of the programme and whether the assessment system is fair.' To achieve this, the Board checks if the exams match the assessment plans for the courses. The Board of Examiners also approves (or disapproves) of the MSc thesis contracts that students have to submit before starting their research project. Members of the Board do not receive any form of training for their tasks, but stated that the Board is able to benefit from the expertise gained in other programmes' Boards of Examiners. One member participates in both the Board of Examiners of the master's programme and the Board of Examiners of the combined BSc/MSc programme Applied Physics.

The Board of Examiners is responsible for drawing up and enforcing the rules and regulations, and for checking the quality of assessment within the programme. The committee concludes that the Board of Examiners fulfils its statutory tasks. The Board of Examiners does not yet actively check for fraud or plagiarism. The committee strongly recommends the Board of Examiners to use software that can detect fraud. It is happy to hear that the Board thinks it is better to make this a standard procedure than to check at random.

The master's research project forms a considerable part of the programme and determines whether or not students have acquired the intended learning outcomes. Consequently, the assessment committee has paid special attention to the assessment procedures of this assignment. The research project culminates in a written report and an oral presentation. The final assessment is done by a MSc Assignment Committee, appointed by the Board of Examiners at the start of the project. The Assignment Committee is led by the chair holder of the research group where the project was carried out. Of the other two members, one is an external staff member to assure an independent vote. An assessment protocol, introduced in 2011, shows which 31 aspects are assessed on a scale from insufficient to very good. 16 aspects relate to the scientific quality of the thesis (25 EC), 15 to general other aspects (20 EC) such as the structure of the text, the quality of diagrams, tables and figures provided in the report, degree of initiative shown and manner of speaking during the oral presentation. The three assessors fill in one assessment form together. The two marks are based on a consensus reached in the Assignment Committee. In this discussion, lecturers find that the assessment form plays a useful role.

The committee was very impressed with the assessment form, which the programme has developed and adopted for assessing the master's research project. The form gives students a good insight into how their final marks were arrived at. However, the committee finds it less desirable that members of Master Assignment Committee fill in one assessment form together. The committee thinks that the best way to assure independence among the supervisors is if assessors give their two marks independently, before reaching a consensus about the final two marks.

3.2 Academic level achieved

The assessment committee has read fifteen master project reports to check whether students have achieved the intended learning outcomes. It concludes that most of these reports were of the level which may be expected of an academic master thesis. At the same time, the committee would have marked some master's theses (considerably) lower.

The committee had some concerns about the level of two theses that were marked with a six. In an extra meeting during the site visit, these two research projects were discussed by a subcommittee of the assessment committee and the examiners of both theses. After hearing their arguments, the assessment committee finds both assessments satisfactory. It does urge the programme to be more careful when students employ Atomic Force Microscopy (AFM) or similar techniques as the main research technique in their final research project.

The committee had a meeting with two alumni from the master's programme. Both were very enthusiastic about the courses, the atmosphere and the lecturers of the programme. They felt that the master's programme had taught them what nanotechnology can add to other fields of study. Both felt well prepared for their current job, in and outside research.

From studying the information provided in the critical reflection and from talking to the graduates selected for an interview, the committee concludes that graduates have no trouble finding a job, most often in research. 76% of the master's students carried on in a PhD-track

(71.1% directly after graduating, the rest within one year after obtaining their degree). Approximately 52% of these PhD-students do their PhD research at the University of Twente. Approximately 27% carry out their PhD research abroad. Of the students not pursuing a PhD, some are still active in academia, either following another master's programme or working as a lecturer or researcher. A minority of graduates finds a job in industry. The committee concludes that the fact that all graduates work in the research area of nanotechnology, plus the fact that graduates perform well in their work, further show that graduates have achieved the intended learning outcomes.

Considerations

The committee finds the assessment procedure adequate. Students are well informed about assessment procedures and they appreciate the various assessment techniques. Assessment forms in the master's programme match the learning aims of the courses and those of the programmes. The committee considered exams in the master's programme to be of a high standard. It was also impressed with the fact that for each exam there are test matrices available containing, for instance, model answers.

Board of Examiners is responsible for drawing up and enforcing the rules and regulations, and for checking the quality of assessment within the programme. The committee concludes that the Board of Examiners fulfils its statutory tasks. The committee is happy to hear that the Board of Examiners will widen its task to detecting fraud and/or plagiarism.

The introduction of a new assessment form for the assessment of the master's research project in September 2011 has led to more clarity on what the final grades are based on. The committee was very impressed with this assessment form, which makes a clear distinction between 31 aspects which are taken into consideration when grading both the scientific and the general academic character of the research project, the report and the oral presentation. The committee suggests that members of the Master Assignment Committee fill in their assessment forms individually before reaching a consensus about the final grades.

To assess the level achieved by the students, the committee examined a range of master's theses. Based on the master theses the committee has studied and the extra session with the examiners, it concludes that the theses match the level that may be expected of a graduate of an academic master's degree programme in nanotechnology.

Conclusion

Master's programme Nanotechnology: the committee assesses Standard 3 as 'satisfactory'.

General conclusion

In the committee's judgement, the master's degree programme Nanotechnology at the University of Twente fulfils the criteria for accreditation. It has noted many positive aspects and suggested several points for improvement. Weighing up those points and the individual assessment of each standard, the committee concludes that the programme 'meets the current generic quality standards and show an acceptable level across its entire spectrum' and consequently can be assessed as 'satisfactory'.

Conclusion
The committee assesses the *master's programme Nanotechnology* as 'satisfactory'.

Appendices

Appendix 1: Curricula Vitae of the members of the assessment committee

Prof. dr. D. (Daan) Lenstra studied Physics at the University of Groningen and got his PhD at the Delft University of Technology on the subject 'Polarization effects in gas lasers'. Since 1979 his research is focuses on the broad area of quantum electronics. He was professor at the VU University Amsterdam from 1991-2006. Between 2000 and 2006 he was also professor at Eindhoven University of Technology. From 2004-2006 he was scientific director of the COBRA Research Instituut was. From November 2006 until his retirement in 2010 he was dean of the Faculty Electrical Engineering, Mathematics and Computer Sciences at Delft University of Technology. Since 2012 he is honorary advisor for the Faculty Electrical Engineering of Eindhoven University of Technology.

Prof. dr. W. (Wim) de Boer from the Karlsruhe Institute of Technology is a leading expert in the fields of particle - and astroparticle physics. His main interest focuses on the search for the elusive dark matter, which makes up more than 80% of the matter in the universe, but its nature is unknown. Prof. De Boer participates in the search for dark matter using the CMS detector at the Large Hadron Collider (LHC) at the European Particle Physics Laboratory CERN in Geneva and the AMS-02 detector on the International Space Station. He also contributed to the phenomenology of Supersymmetry by showing that Supersymmetry can lead to a Grand Unified Theory with a perfect candidate for a dark matter particle. Prof. De Boer received his PhD at Delft University of Technology in 1974. Since 2009, he is member of the Advisory Committee IMAPP, Radboud University Nijmegen.

Prof. dr. J.F. (Friso) van der Veen is Full Professor of Experimental Physics at the ETH-Zürich, where he was appointed in 2000. Since 2002, he is also Head of the Research Department of Synchrotron Radiation and Nanotechnology at the Paul Scherrer Institut in Villigen. Van der Veen studied Physics at Utrecht University where he also finished his PhD (cum laude) in 1978. He has worked as Technical Director at the FOM-Institute for Atomic and Molecular Physics, Amsterdam (1990-1996) and has been Professor of Surface Physics at University of Leiden (1987-1992) and Professor of Technical Physics (1992-1997) and Experimental Physics (1997-2000) at the University of Amsterdam. In 2005, Van der Veen was elected as Corresponding Member of the Royal Academy of Sciences of The Netherlands. He has supervised 31 PhD-dissertations and was (co)author of over 240 research papers.

Dr ir. H.L. (Harald) Tepper studied Chemical Technology at the University of Twente and in 2001 got his PhD in 'computational physics' at the same university. From 2002 until 2007, Tepper was postdoctoral researcher at the University of Utah (USA), and VENI-researcher at the AMOLF Institute in Amsterdam. Since 2007 he has worked in industry. He was management consult at the consultancy firm McKinsey & Company, where he worked, among other things, at large scale change processes, audits and benchmarking of organizations, and the strategy of an academic business school. Since September 2013 he works as Chief Strategy Officer at the Netherlands Forensic Institute. During his studies, he also obtained a diploma as teaching musician (clarinet) at the conservatoire. Tepper was co-founder and chairman of 'De Nationale DenkTank', a foundation which adds a multidisciplinary experience to the curricula for students and PhD students.

C. (Christianne) Vink MSc is didactic coach, educational advisor/trainer and partner at Academic Factory. She studied Psychology at VU University Amsterdam, where she graduated in 2009. From 1999 until 2006, she was a lecturer in refresher courses for (para)medic personnel. From 2010 until 2013, she was a lecturer at the at the University of

Amsterdam Faculty of Science. Vink is specialized in teaching and in developing academic programmes designed to ensure training in 'critical reflection'. Vink is involved as assessor in multiple 'BKO'-trajectories and is well experienced in curriculum assessments of academic programmes. Together with a colleague Vink works on a book on the design of interdisciplinary curricula, forthcoming summer 2014.

L. (Lisanne) Coenen BSc graduated from the bachelor's programme Applied Physics at Delft University of Technology in 2013. At the same time, she finished her pre master Philosophy of Natural Sciences at Leiden University. Since September 2013, she follows the master's programme Applied Physics (track 'Quantumnanoscience'), also at Delft University of Technology. Additionally, she follows the master's programme Philosophy of Natural Sciences at Leiden University. During her bachelor's programme, she was a board member of the student union for Applied Phyiscs in Delft and in 2012 she was a member of the Programme Committee for Applied Physics.

Appendix 2: Domain-specific framework of reference

The goal of a university programme is to prepare students for an independent practise of the profession of the relevant discipline, and to give them the ability to apply the knowledge and skills they have acquired. Dutch university programmes in the domain of (applied) physics and astronomy are required to reach a level which allows the graduate to be competitive in the international research or job market, in particular with respect to countries which have a high profile in these areas. The domain-specific reference frame is meant to be a gauge for reaching this goal.

The framework is based on the one used in the Teaching Programme Assessment (Onderwijsvisitatie) of 2007. The basis for that framework was derived from the qualifications as formulated in the document '*Reference points for the design and delivery of degree programmes in physics'*, which was a product of the so-called *Tuning Project*. The frame of reference to be presented below has been updated by also making use of the more recent '*A European Specification for Physics Master Studies'* of the European Physical Society (2009). The descriptors for the programmes have been formulated in terms of competences acquired by the graduating student, which leads to specific requirements for the curriculum. Programmes with the same name at different (Dutch) universities will in general not be identical. Different specialisations in the research staff or focus on particular subjects leads to differences in the eligible part of the programmes, and there is a structural difference between (the goals of) general universities and universities of technology. As a consequence, there are different ways to comply with the requirements of the reference frame. It is essential, however, that the local choices for, and colouring of the programme fits the internationally accepted standards.

Programme descriptors
Very similar to the BSc programmes, the descriptors for the MSc programmes can be described with three types of competences, as is done below. The sequence within each category is, with few exceptions, taken from what is called the 'Rating of Importance Order' in the Tuning document. The basic difference with the descriptors for the BSc programmes is the different emphasis. While a BSc programme aims at including some aspects of the forefront of knowledge, an MSc programme aims at providing a basis (or opportunity) for originality.

(a) Discipline-related cognitive competences.

	Specific competence	**Description. On completion of the degree course, the student should**
1	Modelling skills	be able to identify the essentials of a process/situation and to set up a working model of the same; be able to perform the required approximations; i.e. critical thinking to construct physical models
2	Problem solving skills	be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems
3	Knowledge and understanding of Physics	have a good understanding of the important physical theories (logical and mathematical structure, experimental support, physical phenomena described);
4	Familiarity with basic and applied research	acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results

5	Frontier research	have a good knowledge of the state of the art in (at least) one of the presently active physics specialties
6	Human / professional skills	be able to develop a personal sense of responsibility, given the free choice of elective/optional courses; be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum
7	Physics culture	be familiar with the most important areas of physics and with those approaches, which span many areas in physics.
8	Absolute standards	have become familiar with highly regarded research in the field with respect to physical discoveries and theories, thus developing an awareness of the highest standards

(b) Discipline-related practical skills.

	Specific competence	Description. On completion of the degree course, the student should
9	Mathematical skills	be able to understand and master the use of the most commonly used mathematical and numerical methods
10	Computer skills	be able to perform calculations independently, even when a small PC or a large computer is needed, including the development of software programmes
11	Experimental skills	have become familiar with most important experimental methods and be able to perform experiments independently, as well as to describe, analyse and critically evaluate experimental data; and to be able to scientifically report the findings

(c) Discipline-related generic competences.

	Specific competence	Description. On completion of the degree course, the student should
12	Literature search	be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development; have good knowledge of technical English.
13	Learning ability	be able to enter new fields through independent study
14	Ethical behaviour (relevant to physics)	be able to understand the socially related problems that confront the profession, and to comprehend the ethical characteristics of research and of the professional activity in physics and its responsibility to protect public health and the environment
15	Specific communication skills	be able to listen carefully and to present difficult ideas and complex information in a clear and concise manner to professional as well as to lay audiences; be able to work in an interdisciplinary team.
16	Managing skills	be able to work with a high degree of autonomy, even accepting responsibility in (project) planning, and in the managing of structures.
17	Updating skills	enjoy the ability to remain informed of new developments and methods, and be able to provide professional advice on their possible impact or range of applications.
18	Foreign language skills	be able to gain command of foreign languages through, usually elective, participation in courses taught in foreign language.

Note that in the generic competences in particular, learning ability and managing and updating skills receive more attention than in the description for the BSc programmes.

2. Programme
The variation in MSc programmes within the domains of Physics, Applied Physics, or Astronomy can be substantial. A general requirement is that the programme aims at teaching the student how to practice their profession in an independent manner. Central to the programme is therefore the individual research assignment, in which the student becomes acquainted with the daily research practice at a frontier of science. Similar requirements apply to Applied Physics programmes, with the understanding that the individual assignment can have a more applied character, and that a project can also have a focus on design. In all cases, the graduation assignment should preferentially be performed within a research group, and the student should be able to function as a fully-fledged member of the group. This requires a workplace which allows daily (social) contacts, and regular exchange of ideas, questions and thoughts with colleagues. This ensures the acquisition of a broad range of research skills.

These days, it is almost inevitable that physicists and astronomers operate in an international setting. The required level of the programme can therefore be indicated by referring to the exchange of information as occurs at scientific conferences and in scientific journals. The graduation work, delivered in the form of a thesis, should therefore link to that level. It should enable the student to enter the international market in a credible way, and research performed during the Master should regularly lead to, or be part of, a scientific publication. Apart from that, the research also has to be presented in oral manner.

In view of their future practicing of a profession, it is important that students learn to work with time constraints. The traditionally large freedom which Dutch students had and partly still have, can easily lead to the neglect of this aspect in study programmes. As this freedom is currently becoming less, it is the more important that the programmed safeguards and stimulates the progress of the student. Time management should be an explicit part of elements of the programme, in particular for a research project or an internship.

Apart from the research practice, the student should deepen his/her knowledge of physics by studying more specialised subjects, often through formal lecture series or study groups. Study programmes will probably want to offer a common core, but much of the direction for study will be furnished by the local research specialisations, and can therefore by quite different in focus.

An increasingly important facet of a disciplinary Master programme is that it can be combined with a different specialization in order to broaden the scope of professions which are open to the graduated student. Prime examples are specializations in the direction of education (leading to the profession of high school teacher, among others), science communication, or science-based business. In the latter case, study elements aiming more specifically at management or governance may be important. It can be expected from a programme that it allows students to orient themselves on the possibilities and ways to match their talents and interests with the job market. In the current Dutch system of a 2-year (120 EC) programme, the minimal requirement for a master's degree in Physics, Applied Physics or Astronomy is deemed to be one year of disciplinary studies. This leaves up to a year for such other specializations.

Appendix 3: Intended learning outcomes

To describe the academic level, the three technological universities in the Netherlands have developed criteria for academic bachelor's and master's degree curricula (3TU-Academic Criteria[1]), also called ACQA criteria, based on the Dublin descriptors. These criteria have been approved by the NVAO. The characterization of a university graduate distinguishes seven areas of competence. The graduate:

1. is competent in one or more scientific disciplines
2. is competent in doing research
3. is competent in designing
4. has a scientific approach
5. possesses basic intellectual skills
6. is competent in cooperating and communicating
7. takes account of the temporal and the social context of their field

The competence areas are elaborated in the various competences. For each competence, it is indicated whether its emphasis is on knowledge (k), skills (s) or attitude (a).

The master graduate Nanotechnology:

1. **Is specialized in a specific field of nanotechnology.**
A master graduate NT is familiar with existing scientific knowledge, and is able to increase and develop this through study.

1a Has a thorough mastery of parts of the relevant fields extending of the forefront of knowledge of:
nanotechnology,
the underlying disciplines of (nano)physics, (nano)chemistry (nano)devices and materials science & technology, and understands the relevant key concepts, theories, methods, and techniques. [ks]

1b Looks actively for structure and connections in these relevant fields. [ksa]

1c Has knowledge, skill and attitude to:

- develop theories and models,
- interpret texts, problems, data, and results,
- perform experiments, gathering of data and modelling,
- make decisions based on data and modelling,

independently in the context of more advanced ideas or applications in nanotechnology. [ksa]

1d Has experimental skills of parts of the relevant fields:

- nanotechnology: synthesis and qualitative and quantitative determination of chemical and physical properties, including clean room operation
- in one of the research topics: nanomaterials, bionanotechnology, nanofluidics, nano-optics, nanoelectronics, nanodevices. [ksa]

1e. Has the ICT skills to process text, data and models. [ksa]

1f. Is able to reflect on standard methods and their presuppositions; is able to question these; is able to propose adjustments, and to estimate their implications. [ksa]

1g. Is able to spot gaps in his own knowledge, and to revise and extend knowledge through study. [ksa]

[1] A.W.M. Meijers, C.W.A.M. van Overveld, J.C. Perrenet, Criteria for Academic Bachelor's and Master's Curricula, TU/e 2005.

2. **Has the knowledge and the skills for doing research in a specific field of nanotechnology.**
A master graduate NT is able to acquire new scientific knowledge through research. For this purpose, "research" means: the development of new knowledge and new insights in a purposeful and methodical way.

2a. Is aware of the research methodology of complex nature in the field of nanotechnology [ksa]
2b. Is, independently, able to do research at a master's level, and can:
- analyze research problems in the field of nanotechnology of a complex nature,
- use the relevant knowledge base,
- formulate the research objectives and, if relevant, the appropriate hypotheses,
- formulate a research plan including the required theoretical and experimental steps, assumptions and approaches,
- execute the different activities of the research plan,
- analyze and evaluate the research results in respect to the defined problem,
- assess research results on its scientific value,
- defend this results against the parties involved. [ksa]

2c. Is observant, and has the creativity and the capacity to discover certain connections and new viewpoints and is able to put these viewpoints into practice for new applications. [ksa]
2d. Is able to work at different levels of abstraction and detail. Given the process stage of the research problem, chooses the appropriate level of abstraction. [ks]
2e. Is able to recognize, systematically collect, analyze and process relevant scientific information [ks]
2f. Is able, and has the attitude to, where necessary, draw upon other disciplines in his own research. [ksa]
2g. Is able to deal with the changeability of the research process through external circumstances or advancing insight. Is able to steer the process on the basis of this. [ksa]
2h. Is, independently, able to contribute to the development of scientific knowledge in one or more areas of the disciplines involved in nanotechnology. [ks]

3. **Some have extended skills for process designing in a specific field of nanotechnology.**
As well as carrying out research, some master graduates NT will also carry out design work. Especially in the track Process Technology, this is an important aspect. Designing is a synthetic activity aimed at the realization of new or modified artefacts or systems with the intention of creating value in accordance with predefined requirements and desires towards products and processes (safety, economics, environment etc.).

3a. Is aware of the design methodology of complex nature in the field of nanotechnology and is aware of design being a cyclic process [ksa]
3b. Is, independently, able to design at master's level, and can:
- analyze product and process design problems in the field of nanotechnology of more complex nature,
- integrate the relevant knowledge base in a design,
- formulate the design requirements, objectives and boundaries, taking into account some safety, sustainability, environmental and economic aspects and describe and translate these requirements in quantitative engineering parameters,
- formulate a design plan including the required global and detailed steps,

assumptions and approaches,
- execute the different activities of the design plan,
- analyze and evaluate the design and design decisions in a systematic manner in respect to the defined requirements,
- make a technical, economical and energy analysis of the chosen design,
- defend this results against the parties involved. [ksa]

3c. Is able to play an active role in production innovation processes. [ksa]

3d. Is able to systematically collect, analyze and process relevant design information from literature, patents, databases and web-sites and is able to estimate leaking information [ks]

3e. Has creativity and synthetic skills with respect to design problems. [ksa]

3f. Given the process stage of the design problem, chooses the appropriate level of abstraction. [ksa]

3g. Is able to deal with the changeability of the design process through external circumstances or advancing insight. Is able to steer the process on the basis of this. [ksa]

3h. Is able, and has the attitude, where necessary, to draw upon other disciplines in his own design. [ksa]

3i. Is able to formulate new research questions on the basis of a design problem. [ks]

4. **Has a scientific approach.**
A master graduate NT has a systematic approach characterized by the development and use of theories, models and coherent interpretations, has a critical attitude, and has insight into the nature of nanoscience and engineering.

4a. Is able to identify and take part in relevant developments. [ksa]

4b. Is able to critically examine existing theories, models or interpretations in the area of his graduation subject. [ksa]

4c. Has great skill in, and affinity with the use of, development and validation of models; is able to choose between modelling techniques. [ksa]

4d. Has insight into the nature of sciences and technology (purpose, methods, differences and similarities between scientific fields, nature of laws, theories, explanations, role of the experiment, objectivity etc.) and has knowledge of current debates about this. [k]

4e. Has some insight into scientific practice (research system, relation with clients, publication system, importance of integrity etc.) and has knowledge of current debates about this. [k]

4f. Is able to document adequately the results of research and design and is able to publish these results. [ksa]

5. **Possesses intellectual skills.**
A master graduate NT has skills in reasoning, reflecting, and forming a judgment. These are skills which are learned, or sharpened, in the context of the chosen area of the NT discipline, and which are generically applicable from then on.

5a. Is, independently, able to reflect critically on his own thinking, decision making and acting, and able to adjust his behavior on the basis of this reflection. [ks]

5b. Is able to reflect on his more strong and weak capabilities with regard to his research, design, organization, and teaching/advising and is able to adjust on the basis of this reflection.

5c. Is able to:
- recognize fallacies,
- reason logically and apply methods of reasoning such as induction, deduction, analogy.

5d. Is able to ask adequate questions, and has a critical yet constructive attitude towards analyzing and solving complex problems in nanotechnology. [ks]

5e. Is able to form a well-reasoned opinion in the case of incomplete or irrelevant data or uncertainty, taking account of the way in which that data came into being. [ks]

5f. Is able to take a standpoint with regard to a scientific argument in nanotechnology and is able to assess this critically as to its value. [ksa]

5g. Possesses basic numerical skills and has an understanding of orders of magnitude. [ks]

6. **Is able to cooperate and communicate with specialists in the chosen track and other stakeholders.**
A master graduate NT is able to work with and for others. This requires not only adequate interaction, a sense of responsibility, and leadership, but also good communication with colleagues and other stakeholders. He is also able to participate in a scientific or public debate in English.

6a. Is able to communicate in writing and verbally in English about research and solutions to problems with colleagues, non-colleagues and other involved parties. [ksa]

6b. Is able to interpret English written scientific literature and textbooks and to understand discussions and scientific debates in English. [s]

6c. Is familiar with professional behavior. This includes: reliability, commitment, accuracy, perseverance and independence as well as respect for others irrespective of their age, social economic status, education, culture, philosophy of live, gender, race or sexual nature. [ksa]

6d. Is able to perform project-based work for complex projects: is pragmatic and has a sense of responsibility; is able to deal with limited sources; is able to deal with risks, is able to make compromises. [ksa]

6e. Is able to work within an interdisciplinary team with great disciplinary diversity. [ks]

6f. Has insight into, and is able to deal with, team roles and social dynamics and Is able to assume the role of team leader. [ks]

7. **Has the ability to integrate insights in the temporal social, environmental, sustainability and safety context into his scientific work.**
Nanotechnology is not an isolated field, and always have a temporal and social context. Beliefs and methods have their origins; decisions have social consequences in time. A master graduate NT is aware of this, and has the ability to integrate these insights into his scientific work.

7a. Is aware of the social, environmental, sustainability and safety aspects of the related industries. [ks]

7b. Has an eye for the different roles of nanotechnology professionals in society: researcher, designer, manager, advisor/teacher and chooses a professional position in society. [ksa]

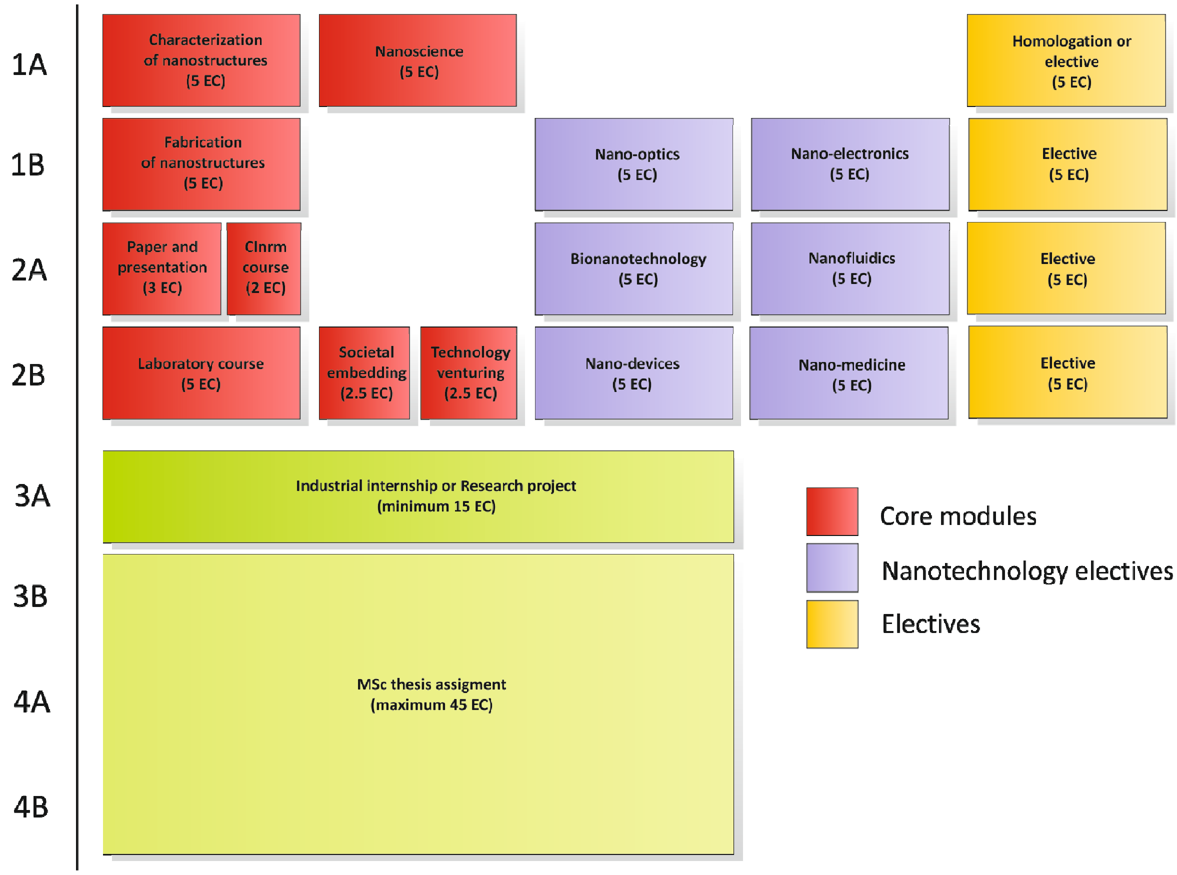
7c. Is able to analyze the place of nanotechnology in society and to discuss the social, environmental, sustainability and safety consequences of new developments in relevant fields with colleagues and non-colleagues and integrates these consequences in scientific work. [ksa]

7d. Is able to analyze and to discuss the ethical and the normative aspects of the consequences and assumptions of scientific thinking and acting with nanotechnology colleagues and non-colleagues (in research, designing and applications) and integrates these ethical and normative aspects in scientific work. [ksa]

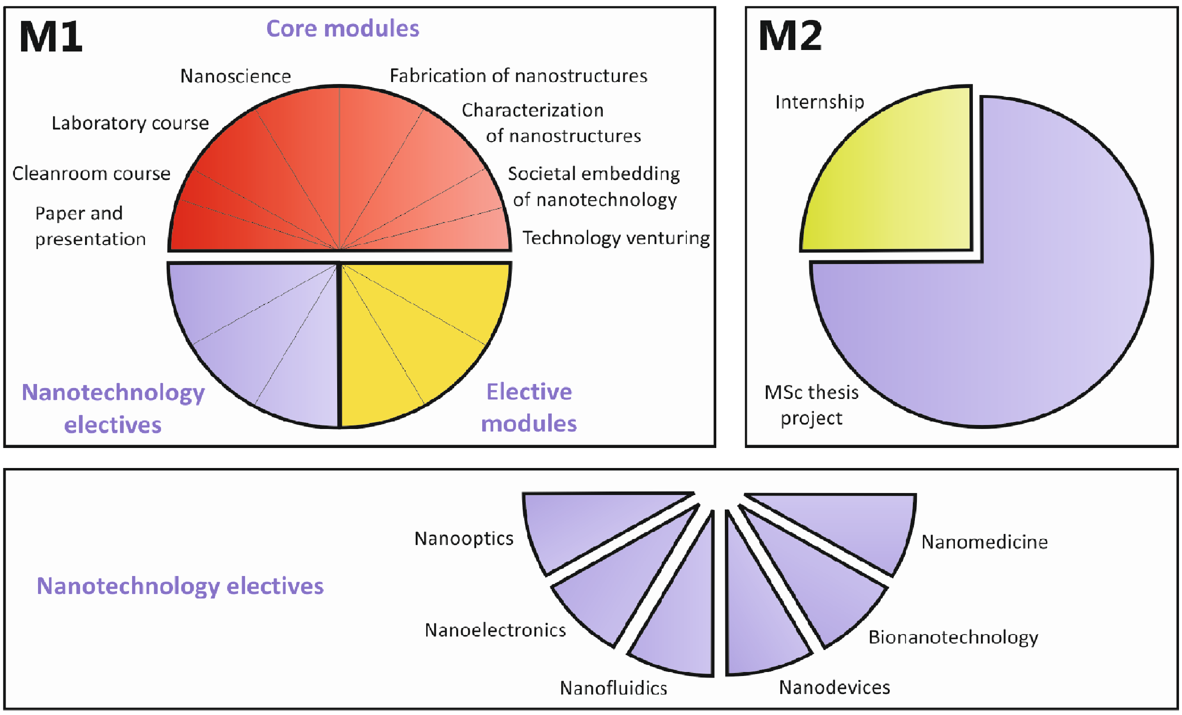
7e. Is familiar with and has experience with the technological organizational processes of an nanotechnology company. [ksa]

Appendix 4: Overview of the curriculum

Schematic overview of the curriculum, organized in blocks:



Curriculum structure:



Appendix 5: Quantitative data regarding the programme

Data on intake, transfers and graduates

Intake:

Year (1)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
International	6	2	3	3	3	7	4	4	3	7	4	**46**
BSc Advanced Technology					1	2	1	2	2	5	4	**17**
BSc Scheikundige Technologie					1	1						**2**
BSc Technische Natuurkunde							1					**1**
BSc Elektrotechniek					1							**1**
BSc Informatica				1								**1**
HBO BSc					1			1	3	2	2	**9**
Total	**6**	**2**	**3**	**4**	**7**	**10**	**6**	**7**	**8**	**14**	**10**	**77**

Success rates:

Cohort(1)	2003	2004	2005	2006	2007	2008	2009	2010	Average
Efficiency at 2 years	3/6	2/2	2/3	3/4	3/7	4/10	4/6	2/4	23/42
	50 %	100%	67 %	75 %	43 %	40 %	67%	50 %	55 %
Efficiency at 2.5 years	6/6	2/2	2/3	3/4	5/7	7/10	6/6	4/4	35/42
	100 %	100%	67 %	75 %	71 %	70 %	100 %	100 %	83 %
Efficiency at 3 years	6/6	2/2	3/3	3/4	6/7	10/10	6/6	4/4	40/42
	100 %	100%	100 %	75 %	86 %	100 %	100 %	100 %	95 %

Teacher-student ratio achieved

	Applied Physics	Chemical Engineering	Electrical Engineering	Nanotechnology
Contribution to Nanotechnology	50%	30%	20%	
Student/staff ratio	15.2	14.8	12.8	14.6

Average amount of face-to-face instruction per stage of the study programme

Year	1	2
Hours	14.5	n/a*

* During the second year, students are working on their internship and master thesis project.

Qualifications of the teaching staff:

Percentage of PhD:

Category	Numbers (m/f)	Total	FTEs	Percentage PhD
Professor (HL)	8 / 0	8	7.2	100%
Associate professor (UHD)	5 / 1	6	6.0	100%
Assistant professor (UD)	8 / 1	9	8.8	100%
Other lecturers	4 / 1	5	5.0	0%
Total	25 / 3	28	27.0	84%

Percentages of basic teaching qualification:

<table>
<tr><th></th><th>Number</th><th colspan="2">Percentage</th></tr>
<tr><td>Received their BKO-certificate</td><td>9</td><td>36%</td><td rowspan="3">64%</td></tr>
<tr><td>Exemption from the course</td><td>4</td><td>16%</td></tr>
<tr><td>Have an equivalent degree</td><td>3</td><td>12%</td></tr>
<tr><td>Have started their course</td><td>6</td><td>24%</td><td rowspan="2">36%</td></tr>
<tr><td>Did not start yet</td><td>3</td><td>12%</td></tr>
</table>

Appendix 6: Programme of the site visit

Dag 1		
9.00	12.45	Voorbereidend overleg van de commissie + inzage documenten
12.45	13.45	Management Dr. ir. Ben Betlem (opleidingsdirecteur NT) Dr. ir. Martin Bennink (opleidingscoördinator NT) Dr. ir. Marloes Letteboer (opleidingsdirecteur TN/APh) Dr. Jeroen Verschuur (opleidingscoördinator TN/APh)
13.45	14.30	Studenten B Technische Natuurkunde Jorrit Bosma (B3) Max Busch (B2) Engbert Miedema (B1) Liesbeth Mulder (B2) Ton Nguyen (B3) Victoria Schermerhorn (B1)
14.30	15.00	Studenten M Applied Physics Carlijn van Emmerik Bram Hesselink* Jan Hofste Julius de Hond Maurice Krielaart Viola Neumann
15.00	15.15	Pauze/intern overleg
15.15	16.15	Docenten Technische Natuurkunde/Applied Physics Prof. dr. ir. Marcel ter Brake Prof. dr. Klaus Boller Prof. dr. ir. Alexander Brinkman Dr. Michel Duits Prof. dr. Jennifer Herek Prof. dr. ir. Jacco Snoeijer
16.15	17.15	Spreekuur/intern overleg commissie
17.15	17.45	Studenten M Nanotechnologie Mathew Dilu Marleen Munsterman Francesca Rivello Mauricio Schmidt
17.45	18.15	Alumni Denise Leusink, MSc (Applied Physics) Daan Stam, MSc (Applied Physics) Verena Stimberg, MSc (NT, vooropleiding HBO-Chemie) Bart Kieviet, MSc (NT, vooropleiding BSc-TN)
19.00		Diner (alleen commissie)

Dag 2		
9.00	9.30	Docenten M Nanotechnologie Drs. Patrick Bliek Dr. ir. Herman Offerhaus Prof. dr. ing. Guus Rijnders Prof. dr. ir. Wilfred van der Wiel Prof. dr. ir. Harold Zandvliet
9.30	10.15	Intern overleg commissie
10.15	11.00	Opleidingscommissies Dr. Stefan Kooij (TN/APh, voorzitter) Dr. ir. Herman Offerhaus (TN/APh) Robin Buijs (student TN/APh) Bob de Ronde (student TN/APh) Prof. dr. ir. Jurriaan Huskens (NT, voorzitter) Henk-Willem Veltkamp (student NT)
11.00	11.15	Intern overleg commissie
11.15	12.00	Examencie Technische Natuurkunde + studieadviseur Prof. dr. Willem Vos (voorzitter) Prof. dr. Paul Kelly Prof. dr. Devaraj van der Meer Prof. dr. Frieder Mugele Ir. Brigitte Tel (studieadviseur)
12.00	12.45	Examencie Nanotechnologie + studieadviseur Prof. dr. ir. Wilfred van der Wiel (voorzitter) Dr. Sonia Garcia Blanco Prof. dr. Frieder Mugele Dr. Peter Schön Ing. Rik Akse (studieadviseur)
12.45	14.15	Lunch, rondleiding, voorbereiding eindgesprek
14.15	15.00	Eindgesprek met management Prof. dr. ir. Hans Hilgenkamp (decaan a.i. TNW) Dr. ir. Ben Betlem (opleidingsdirecteur NT) Dr. ir. Martin Bennink (opleidingscoördinator NT) Dr. ir. Marloes Letteboer (opleidingsdirecteur TN/APh) Dr. ir Jeroen Verschuur (opleidingscoördinator TN/APh)
15.00	17.00	Opstellen bevindingen
17.00	17.30	Mondelinge rapportage

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

s0207896	s1023837	s1059416
s0206822	s0110515	s1089188
s0205400	s0137243	s1206737
s1024183	s1087894	s1184660
s0040142	s1069179	s1552023

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- Study material: books and syllabi, readers, study manuals;
- Minutes and reports of relevant committees (Programme Committee, Board of Examiners);
- Tests and assignments with the assessment criteria and standard answers;
- Summary and analysis of evaluation results;
- Regulations and manuals for internships and thesis;
- Information and documentation for students;
- Documents on the BKO programme;
- Alumni-surveys.

Furthermore, the committee has requested al available course materials for a selection of courses of the past academic year. The following courses have been selected:

Social embedding of nanotechnology
Nanoelectronics
Nanoscience

Appendix 8: Declarations of independence

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: D. LENSTRA

PRIVÉ ADRES: HUIZERWEG 58
1261 AZ BLARICUM

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

DESKUNDIGE

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: UTRECHT DATUM: 8 oktober 2013

HANDTEKENING:

2

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Willem de Boer

PRIVÉ ADRES: Dekan-Hofheinz-Str. 26
D-76229 Karlsruhe

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

[redacted]

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Karlsruhe DATUM: 21. 11. 2013

HANDTEKENING:

2

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: M.F. VAN DER VEEN

PRIVÉ ADRES: SONNENBERGSTRASSE 47
5408 ENNETBADEN
ZWITSERLAND

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

TECHN NAT TU TWENTE

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

nvao
nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: ENNETBADEN

DATUM: 19 dec 2013

HANDTEKENING:

2

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: H. L. Tepper

PRIVÉ ADRES: P/a Nederlands Forensisch Instituut
Laan van Ypenburg 6
2497 GB Den Haag

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Natuurkunde / Sterrenkunde

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht

DATUM: 8 oktober 2013

HANDTEKENING:

2

nvao
nederlands-vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Christianne R Valk

PRIVÉ ADRES: Tumerstraat 33c
1076 VC
Amsterdam

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht DATUM: 8-10-2013

HANDTEKENING:

2

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Lisanne Coenen

PRIVÉ ADRES:

Stil Gezicht 9, 2612 RV Delft

IS ALS DESKUNDIGE / ~~SECRETARIS~~ GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Natuurkunde bij verschillende universiteiten

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

nvao
nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Delft DATUM: 30/10/13

HANDTEKENING:

2

nvao
nederlands - vlaamse accreditatieorganisatie

Qu36

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: John Corpraal

PRIVÉ ADRES: Weerenhof 8207
6536 CA, Nijmegen

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Natuur- en Sterrenkunde (BA en MA)

AANGEVRAAGD DOOR DE INSTELLING:

Universiteit van Utrecht, Universiteit Twente,
Universiteit van Amsterdam, Vrije Universiteit Amsterdam

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

nvao
nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Nijmegen DATUM: 28/1/'14

HANDTEKENING:

2