Technical Medicine

Faculty of Science and Technology,
University of Twente

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CONTENTS

This report was finalized on 28 June 2013.

Report on the bachelor's programme Clinical Technology and the master's programme Technical Medicine of University of Twente

This report takes the NVAO's Assessment framework for limited programme assessments as a starting point.

Administrative data regarding the programmes

Bachelor's programme Clinical Technology

Name of the programme:	Clinical Technology
CROHO number:	50033
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specializations or tracks:	
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-8-2014

Master's programme Technical Medicine

Name of the programme:	Technical Medicine
CROHO number:	60033
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	180 EC
Specializations or tracks:	
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	13-03-2018

The visit of the assessment committee Technical Medicine to the Faculty of Science and Technology of University of Twente took place on 10-12 April 2013.

Administrative data regarding the institution

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

Quantitative data regarding the programmes

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

Composition of the assessment committee

The committee that assessed the bachelor's programme Clinical Technology and the master's programme Technical Medicine consisted of:

- Prof. dr. H.F.P. Hillen (chair), retired professor in Internal Medicine and former Dean, Maastricht University;
- Prof. dr. R.P. Zwierstra, retired professor in Medical Education, University of Groningen;
- Prof. dr. W.J. Niessen, professor in Biomedical Image Processing, Erasmus University Rotterdam, Delft University of Technology;
- R. Gupta, MD, PhD, assistant professor in Radiology, Harvard Medical School, US;
- Prof. dr. A.F.P.M. de Goeij, professor in Curriculum Development, Maastricht University;
- Drs. J. Kropff, PhD candidate, University of Amsterdam.

The committee was supported by dr. H. Verheul, who acted as secretary.

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

Working method of the assessment committee

Preparation
Upon receiving the Critical Reflection report it was checked by the QANU project leader on completeness and quality of the information. After establishing that the report met the demands, it was sent to the committee members. The committee members analysed the Critical Reflection report and formulated questions that were discussed at the start meeting. The secretary compiled specific questions and issues according to subject and/or stakeholder. Besides the Critical Reflections the committee members assessed among them a minimum of fifteen final theses per programme.

The committee held its formal start meeting on April 10, 2013. During the start meeting the committee was instructed about the accreditation framework and the programme of the upcoming visitation. Also a task division was agreed based on disciplinary expertise of the committee members. The responsibility for the assessment of the programme and the final report lies with the full committee.

Site visit
A preliminary programme of the site visit was made by the secretary and adapted after consultation of the committee chair and the programme co-ordinator of the University of Twente. During the site visit meetings were held with a representation of the faculty management, the programme management, alumni, the programme committee and the examination committee. Meetings were also held with representatives of the students and teaching staff of both programmes. The representatives were selected by the programme management, as requested by the committee chair and within the selection framework provided by the committee. The committee has spoken to students from all years and core lecturers and supervisors of all disciplines represented in the programmes. The committee was provided with an overview of the selected respondents and has agreed to the selection prior to the site visit. Appendix 6 of this report provides an overview of the programme and respondents during the site visit.

During the site visit the committee studied the requested documentation. An overview of the documents is given in Appendix 7 of this report. Also, an opportunity for a confidential meeting was given to staff and students.

The committee used the last part of the site visit to discuss the assessment of the programmes and to prepare the oral presentation of the preliminary conclusions. This presentation was limited to a number of general impressions per programme.

The QANU coordinator was present at the start meeting of the visitation committee. The secretary and the coordinator had regular contact by telephone and email during the site visit.

Report
Based on the conclusions of the committee the secretary prepared a concept report that was sent for approval to the committee members. After approval the report was sent to the programme management of the university for a check of possible factual errors. The comments of the programme management have been discussed with the chairman and, if necessary, the other members of the visitation committee. Subsequently the definitive report was approved and sent to the university.

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 presents the findings and considerations of the committee that assessed the *Bachelor's programme in Clinical Technology* and the *Master's programme in Technical Medicine* of the University of Twente. The committee studied the information available and discussed the programmes with representatives of the institution and the programme during a site visit. Based on their positive comments and the identified points for improvement, the committee concluded that both programmes meet and in some respects surpass the current generic quality standards and show at least an acceptable level across their entire spectrum.

Therefore, the committee assesses the *Bachelor's programme in Clinical Technology* and the *Master's programme in Technical Medicine* as satisfactory.

Bachelor's programme in Clinical Technology

Standard 1
The Bachelor programme in Clinical Technology has been established in response to the rapid increase of the use of technology in medicine. Graduates in Clinical Technology are intended to be able to develop and apply solutions to technical-medical problems, consulted by a medical doctor.

The committee is positive about the level of detail in which the intended learning outcomes have been operationalized. In this respect, the programme management has responded adequately to the comments of the 2011 visitation regarding the broadness of the intended learning outcomes. The committee also concluded that the academic and professional levels of intended learning outcomes of the Bachelor programme is according to international standards.

Standard 2
The curriculum of the Bachelor programme of Clinical Technology is well designed and has clear learning trajectories. All elements of the programme's intended learning outcomes are represented in the curriculum. The committee appreciates the design of the professional skills courses and the way the mathematics courses are linked to other elements of the curriculum. The committee would like to see the introduction of an elective and increased attention to humanities and molecular biology and cell biology.

The committee has concluded that the didactical concept underlying the programme is a mix of various approaches. Even though the programme design is based on an engineering heuristic, the didactical concept underlying the work forms and test design remains rather implicit.The teaching staff is qualified and committed, but the committee is concerned that the high work pressure may affect the educational quality. The quality system of the programmes is adequately designed and executed, and the facilities and study guidance system are good.

Standard 3
The committee has carefully examined the quality of the assessments and has concluded that it is sufficient throughout the Bachelor programme. The programme uses a variety of assessment methods that fit the learning goals of the courses. The evaluation of test results can be implemented more structurally in the assessment policy. The system of assessment of both programmes is adequate and the Examination Board fulfils its legal role as independent supervisor of the assessment quality.

The committee has evaluated a representative set of Bachelor theses and has concluded that students demonstrate to achieve the intended learning outcomes.

Master's programme in Technical Medicine

Standard 1
The Master programme in Technical Medicine has been established in response to the rapid increase of the use of technology in medicine. Graduates in Technical Medicine are intended to be able to develop innovative solutions that include the application of technology for technical-medical patient problems and to apply these independently in the diagnosis and therapy of the patients.

The committee is positive about the level of detail in which the intended learning outcomes have been operationalized. In this respect, the programme management has responded adequately to the comments of the 2011 visitation regarding the broadness of the intended learning outcomes. The committee also concluded that the academic and professional levels of intended learning outcomes of the Master programme is according to international standards.

Regarding the Master programme the committee assessed the required level of clinical skills of graduates. In the current competence profile, the required level of four reserved procedures is IV, as defined in the Dutch Framework for Medical Education.[1] Based on an analysis of the medical procedures that are needed to perform and the cooperation with the medical staff in the practical clinical context, the committee concludes that for all reserved procedures an intended learning outcome of level III is sufficient for graduates to fulfil their professional role. In order to further develop and specify its profile and intended learning outcomes, the committee advises the programme to make an international benchmark with comparable programmes at other universities.

Standard 2
The Master programme of Technical Medicine has a clear structure directed to prepare students to work independently as a technical medicine professional. The committee is positive about the organisation of the Clinical Rotations and the level of teaching of the mathematics and technology courses. The programme shows a structural interaction with the research activities at the department and provides good opportunities for scientific and academic development of the students. More attention to humanities and molecular and cell biology would be advisable.

The committee has concluded that the didactical concept underlying the programme is a mix of various approaches and remains rather implicit. The teaching staff is qualified and committed, but the committee is concerned that the high work pressure may affect the educational quality. The quality system of the programmes is adequately designed and executed, and the facilities and study guidance system are good.

Standard 3
The committee has carefully examined the quality of the assessments and has concluded that it is sufficient throughout the Master programme. The programme uses a variety of assessment methods that fit the learning goals of the courses. The committee is specifically positive of the systematic use of the electronic portfolio in the assessment of skills and competences. The evaluation of test results can be implemented more structurally in the

[1] Herwaarden, C.L.A. van, Laan, R.F.J.M., Leunissen, R.R.M. (2009). *Raamplan artsopleiding 2009*. Utrecht, NFU.

assessment policy. The system of assessment of both programmes is adequate and the Examination Board fulfils its legal role as independent supervisor of the assessment quality.

The committee has evaluated a representative set of Master theses and has concluded that students demonstrate to achieve the intended learning outcomes.

Conclusion
Overall the committee is positive about both programmes. Some aspects leave room for improvement, therefore the committee cannot conclude that the programmes systematically surpass the current generic quality standards across its entire spectrum. The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Bachelor's programme Clinical Technology:

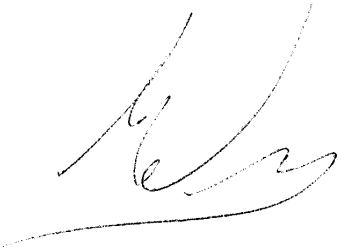
Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

Master's programme Technical Medicine:

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: 28 June 2013



Prof.dr. H.F.P. Hillen, chair

Dr.ir. H.H.M. Verheul, secretary

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

Introduction

The Bachelor programme in Clinical Technology (TG) at the University of Twente started in 2003 and was reviewed and accredited in 2007. The Master programme in Technical Medicine TM) started in 2006 and was reviewed in 2011 and accredited in 2012. For efficiency reasons the University of Twente decided to combine the re-accreditations of the Bachelor and Master programmes in 2014. Both programmes are therefore assessed in in this report.

The University of Twente has six faculties and four research institutes. The Dean of the Faculty of Science and Technology is responsible for the educational programmes, human resources, finances and the integration of education and research. The programme director is responsible for the Bachelor and Master programmes of Technical Medicine, including their human resources and finances. The programmes are part of the educational portfolio of the Faculty of Science and Technology (TNW). MIRA, the Institute for Biomedical Technology and Technical Medicine, is responsible for the research related to the programmes. Research groups contributing to the TG and TM programmes are based in the Faculty of Science and Technology, the Faculty of Electrical Engineering, Mathematics and Computer Science (EWI), the Faculty of Engineering Technology (CTW) and in University Medical Centres (UMC's) and other cooperating hospitals.

The University of Twente is currently implementing organisational and pedagogical changes in all the bachelor's programmes. The Bachelor programme of Clinical Technology will be part of the cluster Health, together with the bachelor's programmes Biomedical Technology and Health Sciences. At the same time the new Twente Education Model (Twents Onderwijs Model, TOM) will be implemented.

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

The Bachelor programme in Clinical Technology and the Master programme in Technical Medicine have been established in response to the rapid increase of the use of technology in medicine. Graduates are intended to be able to develop innovative solutions that include the application of technology for technical-medical patient problems and to apply these independently in the diagnosis and therapy of the patients. Because of the absence of comparable programmes at other Dutch universities, the Domain Specific Reference Framework is identical to the intended learning outcomes of the programmes. The intended learning outcomes are a combination of medical and technological knowledge and skills, as well as a systematic approach to solving medical-technological problems. See Appendix 2 for more information regarding the Domain Specific Reference Framework and the development process of the intended learning outcomes.

The intended learning outcomes of the Bachelor programme are formulated as a competence profile of seven competences that cover the disciplinary aspects, the academic method of thinking and acting, and the situational aspects of their profession. These competences have been operationalized into 63 final qualifications. The competences and the academic level have been based on the Dublin Descriptors and the 3TU Academic Criteria developed by the three Dutch Technical Universities.

The intended learning outcomes of the Master programme are described as six professional roles that the graduate should be able to fulfil: the role of technical medical expert, communicator, collaborator, manager, scholar and professional. These roles are an adaptation of the professional roles in the Dutch Framework of Medical Education[2], which are based on the Canadian Medical Education Directives for Specialists or CanMEDS. The six roles that describe the intended learning outcomes of the Master programme have been worked out into detailed competences. Where relevant, the intended level for each competence has been defined.

The Critical Reflection report describes the process by which the intended learning outcomes have been established and developed. Most notably, the competence profile of the Master programme is the result of a joint committee of the association of the three Dutch Technical Universities 3TU and the federation of medical faculties and academic hospitals NFU. Furthermore, the committee has established during its meetings that the competence profile of both programmes is discussed regularly with alumni, the professional association of technical medicine, and the professional and academic contacts of the programme.

[2] Herwaarden, C.L.A. van, Laan, R.F.J.M., Leunissen, R.R.M. (2009). *Raamplan artsopleiding 2009*. Utrecht, NFU.

Considerations
The committee has analysed and discussed the competence profiles of the Bachelor and Master programmes, and discussed them with students, staff and alumni. The committee is positive about the level of detail in which the intended learning outcomes have been operationalized. In this respect, the programme management has responded adequately to the comments of the 2011 visitation regarding the broadness of the intended learning outcomes. The committee also concluded that the academic and professional levels of intended learning outcomes of both the Bachelor and Master programme are according to international standards. The necessary medical, technical and academic competences are all well represented in the intended learning outcomes according to the committee.

Regarding the Master programme the committee assessed the required level of clinical skills. In the current competence profile, the required level of four reserved procedures is IV, as defined in the Dutch Framework for Medical Education . The committee analysed the medical procedures that graduates need to perform and their cooperation with the medical staff in the practical clinical context. Based on this analysis, the committee concludes that for all reserved procedures an intended learning outcome of III is sufficient for graduates to fulfil their professional role. This means that graduates should be able to perform these procedures in specifically designed training situations or simulated medical practice, but that the performance of the procedures in medical practice does not have to be demonstrated.

Based on the discussions with staff, students and alumni the visitation committee has concluded that in general, the profile of the Technical Medicine programme is recognized by (aspiring) students, teaching staff and employers in the medical sector. The committee is satisfied with the active way in which the profile and intended learning outcomes are discussed with alumni and the professional field by means of the professional association and the medical staff of the hospitals involved in the professional training of the students. A minority of the prospective students, however, appears to expect a predominantly medical programme. It would be advisable for the programme to investigate the motives of aspiring students and if necessary adapt the publicity for students.

In order to further develop and specify its profile and intended learning outcomes, the committee advises the programme to make an international benchmark with comparable programmes. Although programmes in Technical Medicine are still scarce, some comparable programmes have been established at other universities. Examples are the MD programme in Health, Science and Technology at Harvard Medical School and the MSc programme in Medical Technology of the Norwegian University of Science and Technology.

Conclusion
Bachelor's programme Clinical Technology: the committee assesses Standard 1 as satisfactory.
Master's programme Technical Medicine: 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 analysed and discussed the curricula of the Bachelor and Master programme, the course materials, minutes of relevant committees, evaluation results and the digital learning environment Blackboard. For this standard the curricula and didactical principles are briefly described. Subsequently the committee's findings are reported regarding the content and structure of the programmes, the translation of the final qualifications into the curricula, and the didactical principles. Finally the teaching staff, quality management, study load, study guidance and facilities are evaluated.

Programme structure and content
The curricula of the Bachelor and Master programmes in Technical Medicine are included in Appendix 4 of this report.

The three-year Bachelor programme (180 EC) consists of three trajectories: medical, technological and concerning the medical-technical problem-solving approach. The medical trajectory aims to provide students with a thorough knowledge and understanding of the human body and its normal functioning. The human body is represented as a system consisting of several interrelated subsystems. Each subsystem is dealt with in a dedicated course in which the anatomy, physiology, pathophysiology and technology of the subsystem is taught. The technological trajectory consists of applied mathematics and technological concepts used in health care, which are biomedical mechanical engineering, biomedical electrical engineering, biomedical electrical engineering, biophysical technology and biochemical technology. Computer science is not taught separately, but is integrated in various courses. The final component of the Bachelor programme is the multi-disciplinary assignment (MDO). Students work in groups on a unique technical-medical problem and are expected to combine and integrate all the disciplines and competences developed in the previous courses.

The three-year Master programme (180 EC) provides students with the choice between two specialisations. The first specialisation, Medical Imaging and Interventions (MII), addresses the needs of diagnostic imaging techniques and minimally invasive interventions. The second specialisation, Medical Sensing and Stimulation, addresses the use of technology to understand the physiology of the human being. The acquisition, processing and interpretation of medical signals and the ways to influence the biological control systems by various types of stimulation are the main subjects in this track. In both specialisations, the focus of the first year is on gaining understanding of technology based in medical practice. Electives and skills training are also part of the first year programme. The second year consists of four medical rotations of ten weeks each. In these rotations, the students apply the technical-medical problem-solving approach in a practical situation as a resident in a hospital. Students also work on their personal development as a professional during the Clinical Rotations. In the third year 57 EC of the total of 60 EC are dedicated to a more in-depth Clinical Specialisation Rotation in which the final thesis is prepared.

The committee studied the description of the Bachelor and Master programme in the Critical Reflection report as well as the course descriptions provided by the programme during the site visit. A representative selection of courses was studied in more detail. The study guide, literature, group assignments and tests with grading procedures of these courses were examined by the committee. Through the electronic learning environment the committee also had access to all the course material of the programmes. Furthermore, the committee examined the matrices in which the final qualifications of the Bachelor and Master programmes were matched to the learning objectives of individual courses. The structure and contents of the programmes were also discussed extensively with students, teaching staff, alumni and the programme management during the site visit.

The committee concluded that the structure of the Bachelor programme is well designed and enables students to achieve the intended learning outcomes. All elements of the intended learning outcomes are adequately represented in the learning objectives of one or more curriculum courses. The committee is positive about the use of medical and technological course trajectories. The professional skills education is also very well laid out in the programme, for example by practicing patient contacts in increasing level of complexity in the course of the programme. The committee paid special attention to the education of mathematics in the Bachelor programme, because in general, the integration of mathematics education in multidisciplinary programmes is a difficult challenge. The level of mathematics is found to be adequate to meet the end qualifications of the programme and to prepare for the Master programme in Technical Medicine. The committee is also positive about the way in which the learning goals of the mathematics are adapted to the demands of the programme and the integration of mathematical teaching into the medical and technological courses.

The current Bachelor curriculum does not provide for students to choose any elective course. The committee recommends that an elective is introduced into the curriculum, in order to give Bachelor students the opportunity to acquire knowledge and skills in a subject of their particular interest, or to better prepare themselves for a selection of a Master specialisation.

Regarding the Master programme, the committee also concluded that all elements of the intended learning outcomes are represented in the curriculum. The committee is also positive about the structure of the programme. The medical and technological level of the first-year courses are adequate to prepare students for the clinical rotations of the second year. The clinical rotations of the second and third year are well organised and provide students with good opportunities to fulfil the learning objectives. The projects that students carry out in the clinical rotations fit within the profile of the master programme and are of sufficient level. The committee is particularly positive about the structured way the clinical rotations enable students to develop their personal and professional skills.

The committee would like to see more room for humanities courses in the curriculum of both the Bachelor and the Master programme. Subjects like history of medicine, philosophy of science and philosophical ethics would enable students to reflect on the professional, methodological and ethical aspects of their future professional practice, thereby contributing to the intended learning outcomes related to the intellectual competences and the roles of scholar of the Bachelor and Master programmes. Furthermore, humanities courses may provide a counterbalance to the programme's systems-based approach to medicine which, although necessary to function as a technical physician, may become too reductionist and mechanistic.

Furthermore, the committee recommends that more attention be paid to molecular biology and cell biology in both the Bachelor and the Master curriculum. The committee believes that these fields are a major source of technological innovations in a vast array of medical disciplines, and that their importance to the technical physician will continue to grow in the near future.

Didactical concept
The visitation committee studied the Critical Reflection report and course materials to evaluate the didactical concept underlying the programmes. The didactical concept was also a major issue in the meetings with the teaching staff and programme management.

The didactical concept underlying the Bachelor and Master programme is a mix of several elements. An important element is project-based and cooperation based learning. Students are working on technical-medical problems in project groups. The integration of medical and technological aspects according to a systematic problem-solving approach as well as the reflection on the group process are important elements of these assignments. Furthermore, elements of an activating, self-study based didactical approach can be recognized as well as the development from lecture-based education to more autonomous work forms at the end of the programme.

Based on the evaluation of the documents and the meetings with the staff, the committee has come to the conclusion that the programmes do not have an explicit didactical concept that is applied consistently throughout the programme. Although considerable thought is given to the design of individual courses, the underlying didactical principles remain implicit. There does not seem to be an overall vision guiding the design of the curriculum, the course material and work and test forms. The committee believes that the development of such a didactical concept will further improve the educational quality of the programme. The committee therefore recommends that the implicit didactical viewpoints are made explicit in a didactical concept for the Bachelor and Master programme. The implementation of the new educational model of the University of Twente may be used as an opportunity for this.

Teaching staff
During its site visit the committee has established that the teaching staff of both programmes is qualified and committed. In the Master programme, 24 out of the 38 teaching staff involved has a PhD degree, which is sufficient. The committee also observed that there is a strong interaction between teaching staff's research activities and their contribution to the educational programme. The core teaching staff proved to be highly committed to the programme, which was confirmed by the Bachelor and Master students in their meeting with the committee.

Both the Bachelor and the Master programme have a small core teaching staff and a large group of lecturers that only provide a very small contribution to the programme. The total amount of lecturers involved in the Bachelor programme is approximately 140. The committee appreciates the ability to attract this amount of highly qualified staff. However, the committee does expect the programme to become more manageable and efficient if the teaching staff would be reduced to less lecturers which provide a larger contribution to the programme. The same is true for the number of hospitals involved in the clinical rotations. A reduction of the participating hospitals and an increase of the number of resident's places per hospital may increase the efficiency of the work for the teaching staff.

The committee is concerned about the workload of the teaching staff. The student-staff ratio in the Bachelor programme is 39:1, which is high according to the committee. The high workload was an important issue in the meetings with the teaching staff and the programme management. Budgetary aspects and the pressure to produce scientific publications appear to be important causes of the high workload. The committee would acclaim a system comparable to the Harvard track system, in which not only research output but also educational excellence can be the basis of an academic career. The committee therefore recommends to investigate which measures can be taken in budget allocation, efficiency and human resource management to reduce the teaching staff's workload.

Feasibility and study load
The committee has examined the Critical Reflection, course evaluations and other documents to evaluate the feasibility and the study load of the programme. These aspects were also discussed extensively in the meetings with the Bachelor and Master students. Based on this information the committee concludes that both the Bachelor and the Master programme are challenging but feasible. Although there are considerable fluctuations in the pass rates of some courses, no specific barrier courses have been identified by the committee.

The committee is concerned about the efficacy and dropout rate of the programmes. These efficacy is considerably lower than medical programmes at Dutch universities, and the dropout rates are higher. Several reasons for dropout were given by students and staff during the site visit. Some students switched to a medical or technological programme, while others had difficulties with fulfilling the professional competences in a clinical context. The committee recommends that the programme investigates the causes and takes measures to improve the efficacy and dropout rate of both the Bachelor and the Master programme.

Quality system
The programme's quality assurance system is described in the Handbook for Quality Assurance. The system is based on the Plan-Do-Check-Act cycle (PDCA cycle). The Student Representation Committee (SVC), consists of two students for every year of the programme. They organise a pre-evaluation meeting with the students (minimum of 10 students, on a rotating basis). This meeting follows a set agenda to evaluate the course. The report of the student meeting is input for the evaluation meeting with the EKC (Evaluatie Kwaliteits Commissie – Evaluation Quality Committee) consisting of lecturers of the course, the education coordinator and the SVC. The evaluation report is used as input for the preparation meeting of the course the next year.

The committee examined the meeting notes of the relevant committees and discussed the programme's quality system with the student and staff members of these committees. Based on this input, the committee concludes that the programme has an adequate system of quality control. Students experience a low threshold for bringing up issues regarding the educational quality. Issues are addressed and actions are taken and evaluated.

The committee does believe that the quality system relies rather heavily on the students' input. While this has positive aspects as well, the disadvantage of this system is that bottom-up, ad hoc issues dominate the evaluation agenda at the expense of a more systematic evaluation and improvement of the programme.

Study facilities and guidance
The programmes provide the students with good facilities to follow the programmes. At the Experimental Centre for Technical Medicine ECTM students can practice medical

procedures as well as communication skills and professional behaviour in a safe environment. The library is well equipped and accessible, and the facilities provide sufficient room for self-study and group work. The visitation committee is particularly positive about the electronic support system (SVS or Stage Volg Systeem) that was developed by the programme to monitor the activities and results of the students during the clinical rotations. The system is well organised and enables a transparent registration and communication of the competence development of the students.

The students guidance system of the programmes is good. Students have the opportunity to see a student adviser to discuss personal issues related to their study activities. The student advisers are accessible to students. The study advisers proactively seek contact with students, for example by organising workshops. The study guidance is also connected to the professional skills training in the programme, which is applauded by the committee.

Considerations
The committee evaluated the Bachelor programme of Technical Medicine, and has come to the conclusion that the curriculum is well designed with clear learning trajectories. All elements of the programme's intended learning outcomes are represented in the curriculum. The committee appreciates the design of the professional skills courses and the way the mathematics courses are linked to other elements of the curriculum. The committee would like to see the introduction of an elective and increased attention to humanities and molecular biology and cell biology.

The Master programme of Technical Medicine has a clear structure directed to prepare students to work independently as a technical medicine professional. The committee is positive about the organisation of the Clinical Rotations and the level of teaching of the mathematics and technology courses. The programme shows a structural interaction with the research activities at the department and provides good opportunities for scientific and academic development of the students. As in the Bachelor programme, more attention to humanities and molecular and cell biology would be advisable.

The committee has concluded that the didactical concept underlying both programmes is a mix of various approaches and remains rather implicit. The teaching staff is qualified and committed, but the committee is concerned that the high work pressure may affect the educational quality. The quality system of the programmes is adequately designed and executed, and the facilities and study guidance system are good.

In general, the committee is positive about the teaching-learning environment of both programmes. Some aspects however leave room for improvement, which is why the committee cannot conclude that the programmes systematically surpass the current generic quality standard across the entire spectrum of the teaching-learning environment.

Conclusion
Bachelor's programme Clinical Technology: the committee assesses Standard 2 as satisfactory.
Master's programme Technical Medicine: 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

Assessment
During the site visit the committee examined the assessment policy, the procedures regarding testing and examination and the assessment methods of the Bachelor and Master programmes. To this end various assessment materials have been evaluated, such as students' exams and essays, portfolios, assessment keys, assessment forms and test exams. The assessments and assessment system were also discussed with students, staff, Examination Board and programme management. Based on this the committee concludes that in general the exam questions and assignments are clearly formulated, and that the assessments are transparent and in line with the teaching objectives of the courses.

A variety of assessment methods is used in the Bachelor programme, such as written and oral examinations, group and individual assignments, reports, papers, (poster) presentations and the assessment of practical skills. The committee has concluded that the assessment methods are well thought out and that there is a clear relationship between the learning goals and the test methods. Assessment plans are available for all courses, assessment forms are used structurally throughout the programme, and two or more teaching staff are involved in the assessment of tests. The committee has looked into a number of assignments and written exams, and has found no major discrepancies between the assessment by the teaching staff and its own judgement.

The assessment of the theoretical courses of the Master programme is also adequately designed and executed. The Clinical Rotations and the Master thesis project are assessed using an electronic portfolio system (SVS, Student Track System). Students are responsible for completing their portfolio with assignments, reflections on professional skills, and records of executed medical procedures. The committee is positive about the way this system is used to systematically assess the student's achievements on the various learning goals of the Clinical Rotations and thesis project. However, the committee did observe that the registration of reserved clinical procedures in the hospitals was in some cases unclear and incomplete. In principle these registrations are only necessary to assess the reserved procedures beyond level III and therefore not strictly necessary to achieve the intended learning outcomes[3]. However, if the programme will continue to facilitate students to achieve level IV, the registration and assessment should be improved.

In 2012 the assessment policy of both the Bachelor and Master programme has been laid down in a document which has been approved by the programme management and the Examination Board. This document is used to set the agenda for the examination policy in the years to come. The committee has established that the Examination Board of the programmes is in control and fulfils its legal role as an independent supervisor of the quality

[3] Regarding standard 1, the visitation committee concluded that a guaranteed level III is sufficient for all reserved procedures.

of the assessments. The Examination Board has a clear agenda, meets regularly and gives solicited and unsolicited advice regarding the quality of the assessments.

The committee has concluded that assessments are not evaluated in a systematic way. Individual staff members do analyse the validity and reliability of their test questions with quantitative analyses, but this is not a standard procedure in the assessment policy. The committee recommends that the statistical evaluation of assessments should be implemented as a standard element in the assessment policy.

Achieved learning outcomes
Prior to the site visit the committee assessed 15 Bachelor theses and 16 Master theses. One master thesis was assessed as insufficient by the committee, but since the other theses showed no major differences in grading between the programme and the committee, this has been considered an anomaly. Regarding the Bachelor theses there were no major deviations between the assessment of the committee and the programme. The committee graded 3 Bachelor theses and 6 Master theses as excellent, and therefore concludes that the achieved learning outcomes are more than sufficient.

The committee was satisfied with the overall quality of the theses. Both in the Bachelor and the Master theses, the disciplinary level of both the technological and medical elements was satisfactory. The Master theses met the expectations of the committee regarding the innovativeness and methodological rigour of the projects carried out. The committee is positive about the fact that many Master thesis projects result in scientific publications of good quality.

Considerations
The committee has carefully examined the quality of the assessments and has concluded that it is sufficient throughout the Bachelor and Master programme. The programmes use a variety of assessment methods that fit the learning goals of the courses. The evaluation of test results can be implemented more structurally in the assessment policy. The system of assessment of both programmes is adequate and the Examination Board fulfils its legal role as independent supervisor of the assessment quality.

The committee has evaluated a representative set of theses and has concluded that students of both programmes demonstrate to achieve the intended learning outcomes.

Conclusion
Bachelor's programme Clinical Technology: the committee assesses Standard 3 as satisfactory.
Master's programme Technical Medicine: the committee assesses Standard 3 as satisfactory.

General conclusion

Conclusion
The committee assesses the *bachelor's programme Clinical Technology* as satisfactory.
The committee assesses the *master's programme Technical Medicine* as satisfactory.

Appendices

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

Prof. dr. H.F.P. (Harry) Hillen (voorzitter) heeft zijn opleiding tot internist (aandachtsgebied hematologie en oncologie) in Nijmegen gevolgd, waar hij ook in 1975 promoveerde. In 1993 werd hij benoemd tot hoogleraar interne geneeskunde in het bijzonder de medische oncologie aan de Universiteit Maastricht. In 2003 werd hij benoemd tot decaan van de faculteit Geneeskunde aan de Universiteit Maastricht en in 2008 tot vice voorzitter van de Raad van Bestuur van Maastricht Universitair Medisch Centrum. In juni 2008 ging professor Hillen met emeritaat. In zowel zijn academische als niet-academische loopbaan waren onderwijs en de opleiding Geneeskunde belangrijke aandachtsgebieden. Hij was vicevoorzitter van de Nederlandsche Internisten Vereeniging, en in die functie betrokken bij opeenvolgende vernieuwingen van de specialistenopleiding. Professor Hillen beschikt over ruime ervaring in het visiteren van opleidingen. Hij was lid van de commissie Hierziening curriculum Geneeskunde UM in 2001. Vanaf 2002 was hij lid van het overleg Decanen Medische Wetenschappen (DMW). Ook was hij voorzitter van visitatitecommissie die de overgangsbeoordeling voor de EUR, UvA en UL heeft uitgevoerd.

Prof. dr. R.P. (Rein) Zwierstra (vice-voorzitter) studeerde Geneeskunde aan de Rijksuniversiteit Groningen en werd opgeleid als chirurg in Groningen, Deventer en Liverpool (kinderchirurgie). In 1979 verdedigde hij zijn proefschrift: Chirurgische aspecten van schildkliergezwellen, waarna hij als staflid kinderchirurg verbonden was aan de afdeling Heelkunde van het Academisch Ziekenhuis in Groningen. In 1995 werd hij benoemd als bijzonder hoogleraar in de heelkunde, in het bijzonder de heelkundige scholing. Vanaf 1997 was hij werkzaam als directeur van het Onderwijsinstituut van de Faculteit der Medische Wetenschappen te Groningen. In 2002 volgde benoeming als gewoon hoogleraar Medisch onderwijs en opleiding. Hij was tevens lid van de Raad van Toezicht van de instelling voor psychiatrische zorg Zwolse Poort en nam deel aan de visitatie van de opleidingen Tandheelkunde in Vlaanderen. In 2005 werd hij benoemd tot prodecaan onderwijs en opleidingen van het UMCG. In februari 2008 trad hij terug als prodecaan. Hij is thans nog in diverse docent- , advies- en coachtaken werkzaam binnen en buiten de faculteit.

Prof. dr. W.J. (Wiro) Niessen received a MSc degree (cum laude) in Physics from Utrecht University in 1993, and a PhD degree (cum laude) in Medical Imaging from Utrecht University in 1997. From 1997-2004 he was Postdoctoral Researcher, Assistant Professor and Associate Professor at the Image Science Institute of the University Medical Center Utrecht. In this period he was leading research theme groups in the fields of cardiovascular image analysis and image guided interventions. In 2005, he was appointed as a Full Professor of Biomedical Image Processing in the Departments of Radiology and Medical Informatics at the Erasmus MC. His research interests include many aspects of computer vision, biomedical image analysis, and computer assisted interventions. In 2005 he was also appointed Professor at Delft University of Technology, at the faculty of Applied Sciences. Niessen was elected to the Dutch Young Academy (DJA) in 2005, and is Board Member of the Dutch Young Academy since 2009. He is Associate Editor of the IEEE Transactions on Medical Imaging and Elsevier's Medical Image Analysis. He served as a Guest Editor on two Special Issues on Model-Based Image Analysis, and Growth and Motion Analysis of the IEEE Transactions on Medical Imaging, on a Special Issue on Medical Image Computing and Computer Assisted Intervention of Medical Image Analysis, and on a special issue on mathematical methods in biomedical image analysis in the International Journal of Computer Vision.

R. (Rajiv) Gupta MD, PhD received his PhD in Computer Science from the State University of New York at Stony Brook, and his MD Degree from the Cornell University.

Dr. Gupta completed his residency in Radiology at the Massachusetts General Hospital and Harvard Medical School in Boston where he is currently a Neuro and Cardiac Radiologist. At MGH, he is also the Site Miner for the Center for Integration of Medicine and Innovative Technologies. Gupta's research is focused on development and clinical applications of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). At MGH, Gupta also directs the ultra-high resolution volume CT lab. Gupta is also intimately involved in clinical work and the education of residents, fellows and medical students in the department. He regularly lectures in multiple courses in Bio-imaging, CT Physics for Radiation Oncology, Cardiac. In addition to clinical and research activities, Gupta has been an investigator on numerous government and industry-sponsored clinical trials and has participated in the several large industry-sponsored trials.

Prof. dr. A. (Ton) de Goeij is professor aan de Faculty of Health Medicine & Life Sciences aan de Universiteit Maastricht. Prof. dr. Ton de Goeij is opgeleid als biochemicus aan de Universiteit Leiden, waar hij in 1972 afstudeerde. Hij promoveerde cum laude op het proefschrift Biochemical Aspects of Erythropietic Protoporphyria aan de Universiteit Leiden in 1976. Hij werkte als postdoctoral fellow op uitnodiging van Prof. dr. N.I. Krinsky aan de Tufts University School of Medicine, Dept. of Biochemistry & Pharmacology in Boston in 1977, gesteund door een Fullbright-Hayes grant. Daarna deed hij drie jaar onderzoek in het Laboratorium voor Celbiologie & Histologie van de Universiteit Leiden. In 1982 werd hij wetenschappelijk medewerker bij de vakgroep Pathologie van de Universiteit Maastricht en werd in 1984 benoemd tot universitair hoofddocent. Ruim 26 jaar, tot 2008 heeft hij pathobiologisch-oncologisch onderzoek gedaan aan borstkanker en colorectaal kanker, en was copromotor van negen PhD studenten. Daarnaast heeft hij veel organisatorische en uitvoerende functies vervuld in het academisch onderwijs aan studenten geneeskunde en biomedische wetenschappen. Van 1998 tot 2002 was hij gedurende twee benoemingstermijnen voorzitter van de Universiteitsraad. Sinds 1991 is Ton de Goeij internationaal consultant voor curriculumontwikkeling. Hij was de grondlegger van de vierjarige onderzoeksmaster Arts-Klinisch Onderzoeker aan de UM en was van 2007-2011 de programmadirecteur van deze opleiding. Hij kreeg in 2008 de onderwijsprijs van de Universiteit Maastricht en in 2011 de onderwijsprijs van de Faculty of Health Medicine & Life Sciences. Sinds medio 2011 is Ton de Goeij directeur van de opleidingen Geneeskunde aan de UM. In 2012 werd hij benoemd tot hoogleraar Curriculumontwikkeling.

Drs. J. (Jort) Kropff was student Geneeskunde aan het Academisch Medisch Centrum Amsterdam (AMC) en is daar nu promovendus. Daarvoor studeerde hij aan de HVA Amsterdam School of Nursing (ASN). Hij heeft in de afgelopen jaren bestuurlijke ervaring opgedaan; in het studiejaar 2006-2007 als lid van de toetsingscommissie, in het studiejaar 2008/2009 als lijsttrekker MFAS/UvAsociaal en twee jaar als lid van de Facultaire Studentenraad AMC-UvA (waarvan het studiejaar 2008/2009 als voorzitter). Hij was studentlid van de visitatiecommissie die de overgangsbeoordeling voor het Erasmus MC, het AMC en het LUMC (Leiden) heeft uitgevoerd en hij was studentlid van de visitatiecommissie die de toets nieuwe opleidingen 'International Master in Medicine for Saudi Arabian Scholarship Students' van de Universiteit Maastricht heeft beoordeeld.

Appendix 2: Domain-specific framework of reference

The domain specific reference framework for Technical Medicine is a specific framework because the programme is unique. Over the last decades, the need for technical medical professionals has been increasing dramatically. Universities designed a variety of programmes to answer this need. The variety of the programmes is so great and the variety of competent professionals, that both the Ministery of Education and the Ministery of Health Care, but also the Federation of University Medical Centres (NFU) and the union of the 3 Technical Universities (3TU) appointed a committee, "Commissie Zorg met Technologie" (committee care with technology) to create an overview of these professionals, their research and the value of their competences in health care. This overview is important for the policymakers, the employers such as hospitals, patients and caretakers and insurance companies, and also to define those professionals who are competent to use reserved procedures and need to be acknowledged and registered in the Wet BIG.

Technical innovations offer great opportunities for healthcare. Since the Dutch government and the European government give priority to the development of Life Sciences, the NFU and 3TU have extend their cooperation to realise strong and innovative technology & care research programmes.

From the very start of the programme of Technical Medicine, the goal was to educate a new type of technical medical professional competent to treat the individual patient. Fully aware of the novelty of this programme and its aims, the Ministries of Education and Health appointed a number of committees to critically follow this development. This is the only programme in the Netherlands that has had this much supervision:

1. 2003: the bachelor's programme of technical medicine is approved by law.
2. 2004: Committee Sminia (then Rector Magnificus of the VU) I and II: Technology and Care educational programmes. The conclusions are that the intake and flow of TM students must improve and there is a need for a description of the competences. The difficulty at this stage is that the law (Wet BIG) prohibits new professionals to use the reserved procedures.
3. 2006: the start of the master's programme of technical medicine, after successfully passing the test for new educational programmes (Toets nieuwe opleidingen NVAO).
4. 2008: successful accreditation of the bachelor's programme Clinical Technology (*Technische Geneeskunde*).
5. 2008: Report by the Healthcare Inspectorate (IGZ): risks of medical technology are underestimated. The report concludes that the current professionals are not competent in the use of technology. IGZ calls rather urgently for the development of technical medical professionals.
6. 2009: committee Gevers: investigates the obstructions for new professionals in health care competent to use reserved procedures. The conclusion is to incorporate new professionals via the new article 36a in the law in an experimental period. The technical physician, educated at the University of Twente, is an example of such a new professional.
7. 2009: the NFU and 3TU appoints the committee Jaspers to find out in more detail the need and the competences of professionals on the interface of care and technology. There is a growing need for technical medical professionals with the competences to act in individual patient care. More clarity about the exact competences is also wanted.
8. 2011: committee Miedema defines the competence profile of the academic Technical Medical professionals. Technical and medical representatives of the 3TU and NFU create

a competence profile inspired by the CanMEDS roles and the "Raamplan Geneeskunde" and based on the competences of the bachelor's and master's programmes of Technical Medicine. This competence profile describes the competences in roles of the starting technical medical professional. See Section I.2.

9. 2012: successful accreditation of the master's programme of Technical Medicine.
10. 2012: the *Algemene Maatregel van Bestuur (AMvB*) (Order in council of governmental decree) and the explanatory memorandum (*nota van toelichting)* for the embedding of the Technical Physicians into the Dutch law (wet BIG).

This competence profile, jointly supported by the eight university medical centres and the three technical universities, clears the way for the Ministry of Health Care to identify the Technical Medical professional as an article 3 profession, competent to use the reserved procedures independently. In 2012 the *Algemene Maatregel van Bestuur (AMvB*) (Order in council of governmental decree) was written, and the aim is to register TM-professionals in 2013 in the *wet BIG*.

Appendix 3: Intended learning outcomes

Bachelor of Clinical Technology

For each qualification, it is noted whether its emphasis is on knowledge (k), skills (s) or attitude (a).

A Technical Physician:
1. is competent in the discipline of Technical Medicine

A Technical Physician is familiar with existing scientific knowledge and has the competence to expand this knowledge through study.
Understands the knowledge base of the healthy state of the human body and all its subsystems. [ks]
Understands the knowledge base of the general characteristics of the pathophysiological core concepts and their consequences on each of the subsystems. [ks]
Understands the core concepts and the structure and the coherence of the relevant technological disciplines. The TP understands the knowledge base of the essential theories, methods and techniques, and currently topical questions. [ks]
Understands the knowledge base of the core concepts of the supporting disciplines, e.g. psychology. [ks]
Has knowledge of and basic skill in truth-finding and the development of theories and models that belong to Technical Medicine. [ks]
Has knowledge of and basic skill in interpreting texts, data, problems and results in Technical Medicine. [ks]
Has knowledge of and basic skill in experiments, data gathering and simulations in Technical Medicine and its supporting disciplines. [ks]
Has knowledge of and basic skill in the decision-making process in Technical Medicine. [ks]
Is aware of both the presuppositions of the standard methods and their importance. [ksa]
Is able (with supervision) to spot gaps in his own knowledge, and to revise and extend this knowledge through study. [ks]

2. is competent in research and design

A Technical Physician has the competence to acquire new scientific knowledge through research and design. These are defined as follows in this context: **Research: A goal-oriented and methodical increase of new knowledge and insights.** **Design: A synthetic activity aimed at the emergence of new diagnosis or therapies using technology.**
Is able to analyse which pathophysiological core concepts are the base of a disease. [ks]
Is able to analyse which technological core concepts can be used to solve a technical medical problem. [ks]
Is capable (with supervision) of designing a plan based on the analysis of the pathophysiological core concepts for the solution of a technical medical problem, employing technology. [ksa]
Is able to define the supporting disciplines' core concepts essential for professional behaviour in a clinical context. [ks]
Is able (with supervision) to design and execute a research plan based on the analysis and interpretation of results of research to investigate a possible solution for a technical medical problem. [ksa]
Is able (with supervision) to reformulate ill-structured technical medical research problems. [ks]

Is able to defend the new interpretation to involved parties. [ksa]
Is observant, and has the creativity and the capacity to discover certain connections and new viewpoints. [ksa]
Is able (with supervision) to produce and execute a research plan. [ks]
Is able to work at different levels of abstraction. [ks]
Understands the importance of other disciplines (interdisciplinarity), especially those of the basic engineering discipline and the life sciences. [ka]
Is aware of the changeability of the research process through external circumstances or advancing insight. [ka]
Is able to assess research within Technical Medicine on its usefulness. [ks]
Is able (with supervision) to contribute to the development of scientific knowledge in one or more areas of the disciplines involved in Technical Medicine. [ks]

3. is competent in technical medical practice

Based on the integration of knowledge, planning and reflection, the technical Physician is able to apply medical technology in the diagnostic and therapeutic process of the medical practice. The application is focused on innovation.
Has the knowledge and skill needed for the problem solving approach. Can interpret the pathophysiological findings and invent an adequate solution. [ks]
Is able to work systematically on the diagnostic process based on the type of request for help. [ksa]
After analysis of the situation, is able to propose a strategic treatment based on both the generalisation of the knowledge concepts (based on similarities) and the specification based on the exception of the situation (based on the differences). [ks]
Is able to analyse the (theoretical) complaint of the patient in nature and severity and to determine the essence of intervention (under supervision). [ks]
Based on a working hypothesis, can design a plan in compliance with medical ethical aspects. [ksa]
Has theoretical knowledge of technical medical interventions (level II). [ks]

4. has a scientific approach

A Technical Physician has a systematic approach, based on the clinical empirical cycle, characterized by the development and use of theories, models and coherent interpretations, and has a critical attitude and understanding of the nature of science and technology.
Has the knowledge and basic skills to gather, analyse and interpret information and create a responsible solution for a technical medical problem, taking into account the technical medical core concepts (under supervision). [ks]
Has insight into medical, technical and supporting knowledge, and the skills to analyse and interpret research results. [ks]
Based on the analysis and interpretation of research results, the TP is able to make a choice for a responsible approach of a clinical problem (under supervision). [ksa]
Is inquisitive and has an attitude of lifelong learning. [ka]
Has a systematic approach characterized by the development and use of theories, models and interpretations. [ksa]
Has the knowledge and the skill to use models for research and design and assess their value ('model' is understood broadly: from mathematical model to scale-model). [ks] Is able to adapt models for his own use. [ks]
Has insight into the nature of life sciences and technology (purpose, methods, differences

and similarities between scientific fields, nature of laws, theories, explanations, role of the experiment, objectivity etc.) [k]
Has some insight into scientific practice (research system, relation with patients and other clients, publication system, importance of integrity etc.) [k]
Is able to document adequately the results of research and design. [ksa]

5. possesses basic intellectual skills

A Technical Physician is competent in reasoning, reflecting, and judgment. These skills are learned or perfected in the context of a discipline and then generically applicable.
Is able (with supervision) to critically reflect on his or her own thinking, decision making and acting, and able to adjust these on the basis of this reflection. [ks]
Is able to reason logically with Technical Physicians and others: both 'why' and 'what-if' reasoning. [ks]
Is able to recognize modes of reasoning (induction, deduction, analogy etc.) within Technical Medicine. [ks]
Is able to ask adequate questions, and has a critical yet constructive attitude towards analysing and solving basic problems in Technical Medicine. [ks]
Is able to form a well-reasoned opinion in the case of incomplete or irrelevant data. [ks]
Is able to take a standpoint with regard to a scientific argument in Technical Medicine. [ksa]
Possesses basic numerical skills, and has an understanding of orders of magnitude. [ks]

6. is competent in professional behavior

A Technical Physician has a personal working style (expressed in language, behaviour and appearance), in which the norms and values of the profession are visible. This professional behaviour is applied to tasks, work, relationships with others and his own functioning. **This competence requires adequate interpersonal skills, responsibility and leadership, as well as excellent communication with colleagues and non-specialists. He or she is also able to participate in scientific or public debate.**
His professional behaviour is characterized by reliability, involvement, correctness, tenacity, responsibility, and respect for others regardless of their age, social economic status, education, culture, belief, sexuality, race and sex. [ksa]
Is able to estimate or analyse the expert level of others and their need for information, and then transfer information in a suitable manner, in a scientifically responsible way, orally as well as in writing. [ksa]
Has knowledge and skill in dialogues with patients and makes mutually responsible decisions. [ksa]
Is able to communicate in writing in Dutch about the results of learning, thinking and decision-making with colleagues and non-colleagues including health care providers and patients. [ks]
Guards his own learning progress and can integrate any feedback into his actions. [ksa]
Is able to communicate verbally in Dutch about the results of learning, thinking and decision making with colleagues and non-colleagues including health care providers and patients. [ks]
Is able to follow debates about both Technical medicine and the place of Technical Medicine in society. [ks]
Is familiar with professional behaviour. This includes: drive, reliability, commitment, accuracy, perseverance and independence. [ksa]

Is able to perform project-based work: is pragmatic and has a sense of responsibility; is able to deal with limited resources; can handle risks; can compromise. [ksa]
Is able to work within an interdisciplinary team of medical and engineering people. [ks] Understands team roles and can work with social dynamics. Is able to take on the role of team leader.
Has a critical view, from multiple perspectives, on his own technical medical practice and can reflect on his functioning and the effect it has on himself, others and work. The TP can link appropriate consequences to his reflection and is fully aware of the wellbeing of the patient. [ksa]

7. takes into account the temporal and social context

Science and Technology are not isolated and always have a temporal and social context. Ideas and methods have their origins; decisions have social consequences in time. Technical Physicians are aware of this and have the competence to integrate these insights into their scientific work.
Understands the relevant internal and external historical developments of the relevant disciplines and the interaction between these developments. (k)
In decision making, the TP takes into account the financial, logistic and other limiting factors in health care. [ks]
Can adapt his knowledge, skills and attitude to the changing health care landscape, to scientific and social limitations, to new developments, and to ethical, economical and legal boundaries. [ksa]
Is able to analyse and discuss the social consequences of new developments in relevant fields with colleagues and non-colleagues. [ks]
Has an eye for the different roles of Technical medical professionals in society. [ks]
Is able to analyse and discuss the ethical and the normative aspects of the consequences and assumptions of scientific thinking and acting with colleagues and non-colleagues (in research, design and application). Integrates these ethical and normative aspects in scientific work. [ksa]
Chooses a place in society as a professional person. [ksa]

Preface
The CanMeds roles have been used in specifying the competences of the TM professional. A competence is defined here as the ability to adequately perform a professional activity in a specific, authentic professional context based on integrated knowledge, insights, skills and professional behaviour. The competences listed below are needed for the start of the professional practise and will be developed further during the practice and any advanced education.

The intended level (III, IV or V) (Part II. 1.3) is indicated for each competence. Depending on the indicated level, the newly graduated TM professional has the competence to perform the professional activity:

	level
• In specifically designed training situations or simulated medical practice;	***III***
• With prior case-specific instruction and intensive coaching by an experienced medical professional in the authentic professional medical practice;	***IV***
• Independently in an authentic medical practice, with and experienced medical professional available on demand for coaching, and supervision and feedback.	***V***

If no level is given, level V applies.

Competenties

- Technisch-medisch deskundige
- Communicator
- Samenwerker
- Organisator
- Academicus
- Beroepsbeoefenaar

Technisch-medisch deskundige
De juist afgestudeerde TM-professional als technisch medisch deskundige bezit een breed kennis- en vaardighedenpakket uit het medisch en technisch kennisdomein en past dit toe in de medisch-technische praktijk.
De TM-professional levert na verwijzing door een arts een zelfstandige bijdrage aan de diagnostiek en/of behandeling van een patiënt. Hij verzamelt en interpreteert gegevens, maakt een probleemanalyse, neemt de juiste klinische beslissingen en voert deze uit met inachtneming van de grenzen van eigen deskundigheid en bekwaamheid. De TM-professional controleert of de gekozen beslissing en bijbehorende uitvoering van voldoende kwaliteit zijn en of het gezochte effect bereikt wordt.
De TM-professional levert zorg conform de actuele professionele standaard en waar mogelijk evidence based, ethisch onderbouwd en kostenbewust.
De TM-professional communiceert doeltreffend mondeling, schriftelijk, elektronisch met patiënten en hun naasten, en met andere werkers in de maatschappelijke zorg en gezondheidszorg.

De juist afgestudeerde TM professional als technisch medisch deskundige heeft de bekwaamheid als:

1. een breed pakket aan kennis uit het medisch en technologisch kennisdomein toe te passen bij het oplossen van medisch-technische vraagstukken;

- verworven kennis van en inzicht in de gezonde staat van het totale menselijke systeem en al zijn subsystemen in de medisch-technische praktijk toe te passen;
- verworven kennis van en inzicht in essentiële pathofysiologische begrippen en hun gevolgen voor ieder van de subsystemen in de medisch-technische praktijk toe te passen;
- verworven kennis van en inzicht in technologische kernbegrippen en over de structuur en de samenhang van de relevante technologische vakgebieden, inclusief daarbij horende theorieën, nieuwe methoden en technieken en actuele vragen, in de medisch-technische praktijk toe te passen;
- verworven kennis van en inzicht in essentiële begrippen uit ondersteunende disciplines (wiskunde, natuurkunde, scheikunde, elektrotechniek en werktuigbouwkunde) en van hun globale structuur en onderlinge samenhang in de medisch-technische praktijk toe te passen;
- verworven kennis van de wijze waarop theorievorming, modelvorming en validatie plaatsvinden in het eigen en andere relevante vakgebieden en begrip van de wijze van interpretatie, experimenteren, gegevensverzameling, simuleren en besluitvorming, in de medisch-technische praktijk toe te passen;

2. in het medisch-technisch domein door onderzoek nieuwe wetenschappelijke kennis te verwerven en nieuwe behandelplannen en diagnostische methoden te ontwikkelen met behulp van het ontwerpproces (competenties aanvullend aan de competenties beschreven bij de rol academicus).

- te analyseren welke technologische kernbegrippen kunnen worden gebruikt bij het oplossen van medische problemen;
- op basis van de analyse van de anatomie, de fysiologie en de betrokken pathofysiologische kernbegrippen van een medische vraagstelling met behulp van de technologie een oplossing te vinden en er een ontwerp voor te maken;
- de essentiële begrippen van ondersteunende disciplines te gebruiken bij het professioneel handelen in een klinische context;
- op basis van een analyse en interpretatie van resultaten van onderzoek zelfstandig onderzoek op te zetten om een mogelijke oplossing van een probleem te toetsen er een ontwerp van te maken en uit te voeren in een reële of virtuele wereld;
- bepaalde verbanden vanuit diverse gezichtspunten te beschouwen, hypotheses te genereren of toepassingen te ontdekken;
- interdisciplinair te werken en bezit het vermogen te analyseren wanneer bij het onderzoek of het ontwerpproces de inbreng van andere disciplines gewenst is;
- het onderzoeksproces bij te sturen op basis van inzicht in veranderingen door externe omstandigheden of voortschrijdend inzicht;
- binnen de betreffende discipline zelfstandig een bijdrage te leveren aan de ontwikkeling van wetenschappelijke kennis;
- problemen te (her)formuleren en kan deze interpretatie verdedigen tegenover betrokken partijen;
- zelfstandig een ontwikkelingsplan te maken en uit te voeren op basis van synthetische vaardigheden ten aanzien van medische-technische problemen;
- nieuwe onderzoeksvragen te formuleren op basis van een ontwerp- of uitvoeringsprobleem;
- ontwikkelbeslissingen te nemen en deze op systematische wijze te rechtvaardigen en te evalueren.

3. op basis van een integratie van kennis, vaardigheden, competentieplanning en reflectie medische technologie toe te passen in het diagnostisch en therapeutisch proces van de geneeskundige praktijk. Dit handelen is tevens gericht op innovatie.

- de door de arts voorgelegde vraag te verhelderen en in relatie te brengen met het door de individuele patiënt gepresenteerde probleem;
- na analyse van de situatie strategisch te handelen op basis van de generalisatie van het geleerde (op basis van de overeenkomsten) en de specificatie vanuit het inzicht in het uitzonderlijke van de situatie (op basis van de verschillen);
- op basis van de soort hulpvraag het klinisch probleem conform de heuristiek, systematisch door te werken, een eigen voorlopige conclusie te trekken en zo te komen tot een adequate aanpak voor het probleem;
- een gerichte anamnese af te nemen en een gericht lichamelijk onderzoek uit te voeren voor zover relevant in het kader van het medisch-technische vraagstuk;
- indicaties te stellen voor aanvullend onderzoek, het uit te voeren en de uitslagen te interpreteren;
- een probleemanalyse te maken waarin alle onderzoek- en testresultaten worden geduid en een voor de individuele patiënt adequate diagnostisch en/of therapeutisch beleid wordt voorgesteld**;**
- het diagnostisch en/of therapeutisch competentieplan uit te voeren
- het effect van het ingestelde behandelplan te controleren;
- patiënt/familie/derde(n) te informeren en/of te adviseren aangaande het voorgenomen te voeren beleid, rekening houdend met de persoonlijke omstandigheden en voorkeuren van de patiënt als ook de fysieke en emotionele belasting van de patiënt **(IV)**;
- bevindingen en afspraken over het patiëntenprobleem schriftelijk / elektronisch vast te leggen;
- persoonlijke grenzen van eigen kennis en kunde te herkennen en te benoemen en tijdig te besluiten of, en zo ja wanneer, derden geconsulteerd moeten worden **(V)**;
- te verwijzen naar specialistische medische zorg op basis van een eigen overzicht van mogelijke specialistische behandelingen **(IV)**;
- basale eerste hulp te geven;
- medisch-technische handelingen waaronder de volgende voorbehouden handelingen uit te voeren:
    1. heelkundige handelingen, waaronder wordt verstaan handelingen liggende op het gebied van de geneeskunst, waarbij de samenhang der lichaamsweefsels wordt verstoord en deze zich niet direct herstelt **(III)**;
    2. endoscopieën **(III);**
    3. catheterisaties **(III);**
    4. injecties **(IV);**
    5. puncties **(IV);**
    6. handelingen op het gebied van de individuele gezondheidszorg waarbij gebruik wordt gemaakt van radioactieve stoffen of toestellen die ioniserende straling uitzenden **(IV);**
    7. electieve cardioversie **(III);**
    8. defibrillatie **(IV);**
    9. steenvergruizing voor geneeskundige doeleinden **(III).**

Het basale inzicht in deze klinische vaardigheden wordt verworven in het bachelor's programma door het onderwijs in anatomie, fysiologie, pathofysiologie. In het master onderwijs worden alle voorbehouden handelingen getraind behalve de steenvergruizing voor geneeskundige doeleinden. Deze wordt op niveau III onderwezen in het bachelor vak: nier en urinewegen.

4. relevante informatie ten aanzien van het medisch-technische probleem op te zoeken en te integreren in de eigen praktijk;

- de wetenschappelijke waarde van informatiebronnen in te schatten;
- schriftelijke en elektronische informatiebronnen te raadplegen en de gegevens daaruit te interpreteren;
- andere deskundigen te raadplegen.

5. met andere zorgverleners doeltreffend te communiceren in woord, geschrift en elektronisch, over de aan hem/haar toevertrouwde patiëntenzorg;

- zich goed in de Nederlandse taal uit te drukken;
- te signaleren wanneer inzet van een tolk-vertaler nodig is en deze in te schakelen;
- respect te tonen voor en adequaat om te gaan met andere denkwijzen en ander jargon van zorgverleners uit andere disciplines.

6. te reflecteren op het eigen medisch-technisch handelen en op de invloed hierop van eigen attitude, normen en waarden;

- te reflecteren over de sterke en zwakke punten in het eigen medisch-technisch handelen;
- morele standpunten te verduidelijken en deze te verantwoorden tegenover patiënten en collega's in de maatschappelijke zorg en gezondheidszorg;
- impliciete en expliciete morele en ethische kwesties die in de praktijk spelen te herkennen en daarbij de eigen mening over wat goed medisch-technisch handelen is kritisch tegen het licht te houden;
- een eigen opvatting over verantwoordelijkheid in concrete situaties rondom patiëntenzorg en zorgbeleid te verwoorden.

Communicator

De juist afgestudeerde TM-professional als communicator gaat een doeltreffende relatie aan en onderhoudt deze met patiënten, hun naasten en andere werkers in de maatschappelijke zorg en gezondheidszorg. De TM-professional gebruikt (medisch) communicatieve vaardigheden om hooggekwalificeerde zorg te bieden.

De juist afgestudeerde TM professional als communicator heeft de bekwaamheid:

- met patiënten een therapeutische relatie op basis van wederzijds begrip, empathie en vertrouwen aan te gaan en te onderhouden;
- te zorgen voor open en respectvolle communicatie en empathie en betrokkenheid te tonen;
- basale en waar nodig meer complexe gespreksvaardigheden toe te passen in een gesprek met patiënten, hun naasten en collega's in de maatschappelijke zorg en gezondheidszorg (ook opgenomen in de rol *"samenwerker" (***IV)***)*;
- een goed evenwicht tussen persoonlijke en professionele rollen te bewaren en respect te tonen voor de intermenselijke verschillen in professionele relaties **(III)**;
- de Nederlandse taal in woord en geschrift goed toe te passen.
- informatie over het patiëntprobleem van de patiënt te verzamelen en de verzamelde informatie te integreren;
- op patiëntgerichte wijze de anamnese af te nemen waarbij gelet wordt op zowel de medische als op de communicatieve aspecten;
- de hulpvraag van de patiënt te exploreren;
- voor open en respectvolle communicatie tijdens het lichamelijk onderzoek te zorgen.

- relevante informatie met de patiënt, de familie en naasten of andere werkers in de maatschappelijke zorg en gezondheidszorg te bespreken om zo optimale zorg aan de patiënt te kunnen leveren;
- een patiënt/familie/derde(n) te informeren;
- een patiënt/familie/derde(n) te adviseren aangaande de diagnose en het voorgenomen te voeren beleid, rekening houdend met persoonlijke omstandigheden en voorkeuren van de patiënt alsook de fysieke en emotionele belasting voor de patiënt **(IV)**.
- adequaat om te gaan met diverse patiëntengroepen zoals kinderen, ouderen, mannen en vrouwen en patiënten met verschillende culturele achtergronden;
- met interculturele situaties in de zorg om te gaan en de eigen interpersoonlijke sterktes en zwaktes daarin te evalueren;
- rekening te houden met mogelijke etnische achtergronden en met culturele en maatschappelijke onderwerpen die in de samenleving een rol spelen welke van invloed kunnen zijn op het leveren van zorg aan individuen in de samenleving (ook opgenomen in de rol *'beroepsbeoefenaar');*
- een gesprek met een patiënt en diens familie (tweegesprek) te voeren **(IV)**;
- een gesprek met een patiënt te voeren rekening houdend met de leeftijd van de patiënt.

Samenwerker
De juist afgestudeerde TM-professional als samenwerker bouwt een collegiale samenwerking op en werkt doeltreffend samen in een multidisciplinair samenwerkingsverband om te komen tot besluitvorming rond optimale patiëntenzorg, onderwijs en/of onderzoek.
De TM-professional werkt doeltreffend samen met patiënten, patiëntengroepen en andere werkers in de maatschappelijke zorg en gezondheidszorg. De TM-professional brengt informatie over, onderhandelt, geeft leiding, voert consultaties uit en participeert in intercollegiale toetsing.

De juist afgestudeerde TM professional heeft als samenwerker de bekwaamheid:

1. in samenspraak met de patiënt op doeltreffende wijze tot samenwerking te komen met andere zorgverleners binnen de maatschappelijke zorg en de gezondheidszorg;
- een zorgplan voor de patiënt te ontwikkelen in samenspraak met andere zorgverleners en de patiënt; en toe te zien op de uitvoering **(IV)**;
- basale en waar nodig meer complexe gespreksvaardigheden toe te passen in een gesprek met patiënten, hun naasten en andere werkers in de maatschappelijke zorg en gezondheidszorg (ook opgenomen in de rol *"communicator")* **(IV)**.

2. een doeltreffende bijdrage aan interdisciplinaire teams op het gebied van patiëntenzorg, onderwijs en onderzoek te leveren;
- samen te werken in teamverband (ook opgenomen in de rol "*organisator*");
- om de mening van andere teamleden te accepteren, te overwegen en te respecteren om aldus te komen tot besluitvorming;
- verschillende rollen van professionals in de samenleving te herkennen en bewust te kiezen voor een eigen rol;
- inzicht te tonen in groepsprocessen en hun invloeden op het zorgproces.

Organisator
De juist afgestudeerde TM-professional als organisator levert een bijdrage aan besluiten over beleid en de toewijzing van beperkte financiële, materiële en personele middelen. De TM-professional stemt op een verantwoorde wijze taken onderling op elkaar af in het werk - op

strategisch, tactisch en operationeel niveau - en daarbuiten. De TM-professional prioriteert taken, voert deze, waar nodig in een team, uit en evalueert.

De juist afgestudeerde TM professional heeft als organisator de bekwaamheid:
- doelgericht en doeltreffend gebruik te maken van informatietechnologie;
- in de medische praktijk gebruik te maken van geautomatiseerde apparatuur;
- waar relevant een elektronische patiëntadministratie en/of elektronisch patiëntendossier te gebruiken;
- om te gaan met beveiligingsaspecten rondom elektronisch dataverkeer van patiëntgegevens.
- de eigen werkzaamheden adequaat te organiseren, rekening houdend met de context waarin gewerkt wordt;
- hoofd- en bijzaken te onderscheiden;
- het werk te organiseren en prioriteiten te stellen;
- samen te werken in teamverband (ook opgenomen in de rol "*samenwerker*");
- problemen in de organisatie van het werk te signaleren en mogelijke oorzaken op te sporen.
- te laten blijken goed geïnformeerd te zijn over het Nederlandse gezondheidszorgsysteem en de invloed hierop van maatschappelijke en politieke ontwikkelingen. Deze kennis doeltreffend en efficiënt voor de eigen functie en/of organisatie te benutten;
- kennis van de structuur, werking en financiering van het Nederlandse maatschappelijke en gezondheidszorgsysteem in de praktijk toe te passen;
- waar nodig adequaat beslissingen te nemen over het effectief inzetten van gelimiteerde middelen voor gezondheidszorg en ter zake bewust actie te nemen **(IV)**.
- uitgangspunten van kwaliteitszorg (bewaking, bevordering, waarborging) in de praktijk toe te passen.
- kritische situaties en risico's tijdig te onderkennen en hierop adequaat in te spelen;
- waar relevant een kwaliteitsmodel in de praktijk toe te passen **(IV)**.

Academicus
De juist afgestudeerde TM-professional als academicus levert een wetenschappelijke bijdrage aan de beoordeling, opbouw en begrip van kennis en kunde van de gezondheidszorg. De TM-professional geeft onderwijs en/of bevordert onderwijs aan studenten, patiënten en anderen. De TM-professional neemt klinische beslissingen waar mogelijk op wetenschappelijk verantwoorde wijze, erkent het belang van levenslang leren en fungeert hierin als rolmodel.

De juist afgestudeerde TM professional heeft als academicus de bekwaamheid:
- een empirisch wetenschappelijk onderzoek op te zetten en uit te voeren;
- een probleem- en vraagstelling te formuleren;
- een literatuuronderzoek uit te voeren;
- een methodologisch verantwoorde opzet te maken;
- gegevens te verzamelen;
- een data-cleaning en –invoer uit te voeren;
- een statistische analyse uit te voeren;
- onderzoeksresultaten schriftelijk te rapporteren;
- onderzoeksuitkomsten te presenteren en te bespreken.
- onderwijs voor patiënten, studenten en anderen te ontwerpen en te verzorgen **(III)**.

- onderwijskundige principes toe te passen in contacten met patiënten, studenten, opleiders en zorgverleners;
- anderen te helpen hun leerbehoeften te identificeren.
- een systematische aanpak te hanteren, gebaseerd op de klinisch empirische cyclus en gekenmerkt door de ontwikkeling en het gebruik van theorieën, modellen en
- samenhangende interpretaties te maken, heeft een kritische houding en inzicht in wetenschap en technologie;
- voor een medisch probleem informatie te verzamelen, te analyseren en te interpreteren en met inachtneming van de medisch technologische kernbegrippen en de essentiële technologische begrippen te komen tot een verantwoorde aanpak voor het oplossen van een medisch probleem
- de resultaten van onderzoek te analyseren en te interpreteren op basis van de medische, technologische en ondersteunende kernbegrippen
- op basis van een analyse en de interpretatie van de resultaten van onderzoek een keuze te maken voor een verantwoorde aanpak van een klinisch probleem**;**
- inzicht in de aard van wetenschap en technologie en kennis van actuele discussies hierover toe te passen (doel, methoden, verschillen en overeenkomsten tussen wetenschapsgebieden, aard van wetten, theorieën, verklaringen, rol van experiment, objectiviteit etc);
- inzicht in de wetenschappelijke medisch technologische praktijk en de actuele discussies hierover toe te passen;
- resultaten van onderzoek en ontwerpen adequaat te documenteren en te publiceren met de bedoeling bij te dragen aan de kennisontwikkeling van het technisch medische vakgebied.
- te redeneren, te reflecteren en zich een oordeel te vormen
- reflecteren op standaardmethoden en gehanteerde vooronderstellingen; kan deze in twijfel trekken; kan aanpassingen voorstellen en de reikwijdte ervan inschatten;
- zelfstandig kritisch te reflecteren op eigen overwegingen, besluiten en handelen en op basis hiervan zijn gedrag bij te sturen;
- logisch te redeneren en redeneerwijzen zoals inductie, deductie, analogie en dergelijke toe te passen;
- adequate vragen te stellen en een kritisch constructieve houding te hanteren bij het analyseren en oplossen van klinische problemen;
- een beredeneerd oordeel te vormen in het geval van incomplete of irrelevante data;
- een standpunt in te nemen ten aanzien van een wetenschappelijk betoog in het vakgebied en dit kritisch op waarde te schatten;
- objectief en verstandig om te gaan met informatie verstrekt door belanghebbende(n);
- numerieke vaardigheden te gebruiken en een oordeel te vormen op basis van besef van grootte-ordes.
- een persoonlijke leerstrategie te ontwikkelen, implementeren en documenteren;
- persoonlijke leerbehoeften te identificeren en een geschikt studie-/ bijscholingsplan te ontwerpen;
- de eigen vakbekwaamheid te onderhouden en te bevorderen door zichzelf voortdurend op de hoogte te houden van de belangrijkste ontwikkelingen in de technische en medische wetenschappen;
- het nieuw geleerde in de praktijkvoering te integreren.

- op sterke en zwakke kanten in het eigen functioneren te reflecteren en daardoor sturing te geven aan het eigen leerproces en verantwoordelijkheid te nemen voor de eigen professionele groei met als doel levenslange ontwikkeling als TM professional
- adequaat vast te stellen of de ontwikkeling van de verschillende competenties op het gewenste niveau is en als dat niet het geval is, te analyseren welke vaardigheden, kennisgebieden of persoonlijke aspecten extra aandacht behoeven;
- adequate acties te ondernemen om de competenties naar het gewenste niveau te tillen;
- tot een weloverwogen beroepskeuze te komen die past bij de eigen mogelijkheden.

Beroepsbeoefenaar

De juist afgestudeerde TM-professional als beroepsbeoefenaar vervult een unieke maatschappelijke rol om de gezondheid en het welbevinden van de samenleving naar een zo hoog mogelijk niveau te brengen. De TM-professional beoefent de patiëntenzorg volgens de hoogst geldende medische en ethische standaarden binnen het Nederlandse en Europese juridische kader. De TM-professional spant zich voortdurend in om de standaarden van zijn vakgebied volledig te beheersen

De juist afgestudeerde TM professional heeft als beroepsbeoefenaar de bekwaamheid:

- op een eerlijke, betrokken wijze hooggekwalificeerde zorg te leveren, met aandacht voor de integriteit van de patiënt;
- rekening te houden met mogelijke etnische achtergronden en met culturele en maatschappelijke onderwerpen die in de samenleving een rol spelen welke van invloed kunnen zijn op het leveren van zorg aan individuen in de samenleving (ook opgenomen in de rol *'communicator')*;
- de grenzen ten aanzien van de privé-sfeer van de patiënt te respecteren waar deze buiten het kader van de hulpverlening valt;
- op professionele wijze een relatie met een patiënt te beëindigen.
- professioneel gedrag in de gezondheidszorg, wetenschappelijk onderzoek en onderwijs te demonstreren;
- objectief om te gaan met informatie verstrekt door belanghebbende(n) (ook opgenomen in de rol van "*academicus*");
- een goed evenwicht te bewaren tussen persoonlijke en professionele rollen en respect te tonen voor de intermenselijke verschillen in professionele relaties (ook opgenomen in de rol *'communicator'*) **(III)**;
- (medisch) onprofessioneel gedrag te herkennen en hierbij adequate actie aan te geven **(III)**;
- Inzicht te tonen in het belang open en integer relaties met de belanghebbende partijen in de gezondheidszorg te onderhouden en het belang van de patiënt en patiëntengroepen in deze relaties voorop te stellen **(III)**.
- hun medisch-technische praktijk op een ethisch verantwoorde manier te beoefenen en de juridische en professionele verplichtingen van het lidmaatschap van een zelfregulerende groep te respecteren;
- zich verantwoordelijk te tonen voor eigen handelen, zich te verantwoorden en toetsbaar op te stellen;
- ethische dilemma's te herkennen en kennis van ethische concepten relevant voor de gezondheidszorg in de praktijk te hanteren;
- rekening te houden met de afhankelijke positie van de patiënt;
- gevoelens van onvrede aanwezig bij de patiënt en/of zichzelf over de relatie te signaleren en deze bespreekbaar te maken;

- kennis van de juridische concepten in de gezondheidszorg in de praktijk toe te passen;
- medische fouten te (h)erkennen en te melden bij de daarvoor bestemde instanties;
- inzicht te tonen in de belangen van de beroepsgroep en aan te geven hoe deze kunnen worden behartigd **(IV)**.
- op het eigen handelen in de medisch-technische praktijk te reflecteren, in relatie tot de eigen gevoelens en cognities;
- inzicht te tonen in de onzekerheden die aan de eigen medisch-technische beroepsuitoefening verbonden zijn en hiermee om te gaan;
- te reflecteren op het eigen functioneren in moeilijke, indrukwekkende of schokkende situaties; eigen gevoelens, normen en waarden in relatie tot existentiële vragen over leven, dood, ziekte en gezondheid te onderkennen **(IV)**;
- adequaat om te gaan met fouten van zichzelf of van anderen, eigen fouten tegenover patiënten en collega's te erkennen en er lering uit te trekken **(IV)**;
- te reflecteren op de wederzijdse beïnvloeding van werk en privé-leven, stoornissen in de verhouding werk en privé-leven te herkennen en hierop adequaat te reageren **(III)**;
- inzicht te tonen in eigen gevoelens, remmingen, normen en waarden in relatie tot bepaalde gevoelens opgeroepen door contact met een patiënt (of iemand in de directe omgeving van de patiënt), zoals gevoelens van irritatie, afkeer, schaamte, genegenheid, verliefdheid en erotiek **(IV).**

Appendix 4: Overview of the curricula

Bachelor of Clinical Technology 2011-2012

Curriculum bachelor 2011-2012

1 Sept 2011

Anatomy + Imaging techniques 5 EC	Molecular cell biology, biochemistry + genetics 7 EC	Introduction Pathophysiological core concepts 7 EC	Measuring and processing of signals 4 EC	Regulation and integration (incl. endocrine system) 6 EC	Rotation 1st year 3 EC	Computerised applications 4 EC	Bloodforming and immune system 7 EC
Functions of 1 variable 5 EC	Signal analysis 4 EC	3D Mathematics + Matlab 5 EC	Communication skills &			professional behaviour 1 3 EC	

Cardiovascular system 7 EC	Respiratory system 7 EC	Digestive system 7 EC	Rotation 2nd year 3 EC	Neural system 10 EC	Body in Motion 11 EC
Communication skills & professional behaviour 2 3 EC		Epide-		-miology + medical statistics 5 EC	Health care law 1 3 EC
Vector analysis 4 EC					

Communication and data management 4 EC	Sensory System 7 EC	Rotation 3rd year 3 EC	Uro-genital system 9 EC	Biomaterials 5 EC	Applied Cell Biology 5 EC	MDO 12 EC
Epidemiology + Statistics + Medical te			chnology assessment 7 EC	Comm. skills & professional behaviour 3 2 EC		
				Health care law 2 3 EC		
				Medical technology ethics 3 EC		

Orange = human subsystem and advanced courses
Green = supporting courses
Purple =courses in communication and professional behavior
Blue =research methods, statistics, medical technology assessment, law and ethics
White = rotations, ICT courses and final bachelor assignment MDO

M 1: Medical Signaling

First quartile	Second quartile	Third quartile	Fourth quartile
5 EC Biological Control Systems *P. Veltink*	**5 EC** Advanced Techniques for Signal Analysis *C. Heida*	**5 EC** Identification of Human Motor Control *H. van der Kooij*	**5 EC** Dynamic behaviour of Neural Networks *M. van Putten*
5 EC Circulation and Ventilation *B. Lansdorp*	**5 EC** Elective course	**5 EC** Biomedical Signal Acquisition *W. Olthuis*	**5 EC** Elective course
3 EC Injections, punctures & catheterizations *E. Reeuwijk*	**3 EC** Surgical skills *E. Reeuwijk*	**3 EC** Advanced Life Support *B. Lansdorp*	**3 EC** Endoscopic skills *E. Reeuwijk*
4 EC Case 1		**4 EC** Case 2	

M 1: Robotics and Imaging

First quartile	Second quartile	Third quartile	Fourth quartile
5 EC Radiation Expertise *W. Moerman*	**5 EC** Microscopic Detection *V. Subramaniam*	**5 EC** Reconstruction and Visualisation *K. Slump*	**5 EC** Elective course
5 EC Molecular Interactions for Imaging Technologies *B. ten Haken*	**5 EC** Elective course	**5 EC** Robotics for Medical Applications *S. Misra*	**5 EC** Surgical Navigation Technology *F. vd Heijden*
3 EC Injections, punctures & catheterizations *E. Reeuwijk*	**3 EC** Surgical skills *E. Reeuwijk*	**3 EC** Advanced Life Support *B. Lansdorp*	**3 EC** Endoscopic skills *E. Reeuwijk*
4 EC Case 1		**4 EC** Case 2	

M 1: Reconstructive Medicine

First quartile	Second quartile	Third quartile	Fourth quartile
5 EC Elective Course	**5 EC** Microscopic Detection *V. Subramaniam*	**5 EC** Elective course	**5 EC** Tissue Engineering in Regenerative Medicine *L. Moroni*
5 EC Cellular Pathology *B. Kusters*	**5 EC** Advanced Cell Biology *J. de Boer*	**5 EC** Immunology & Transplantation *I. Joosten*	**5 EC** Biomaterials & Human Body Interactions *A. van Apeldoorn*
3 EC Injections, Punctures & Catheterizations *E. Reeuwijk*	**3 EC** Surgical skills *E. Reeuwijk*	**3 EC** Advanced Life Support *B. Lansdorp*	**3 EC** Endoscopic skills *E. Reeuwijk*
4 EC Case 1		**4 EC** Case 2	

M 2

First quarter	Second quarter	Third quarter	Fourth quarter
15 EC Clinical rotations	**15 EC** Clinical rotations	**15 EC** Clinical rotations	**15 EC** Clinical rotations

M 3

3 EC Laboratory Animal Science
57 EC Clinical Specialization Rotation

Appendix 5: Quantitative data regarding the programmes

Data on intake, transfers and graduates

Bachelor of Clinical Technology

	2006-2007	2007-2008	2008-2009	2009-2010	2020 UT target
Intake	98	96	100	101	
Continuation within 1 year	100% (=79)	100% (=86)	100% (=86)	100% (=88)	
Grad. within 3 years	43%	38%	31%	34%	
Grad. within 4 years	68%	58%	66%		
Grad. within 5 years	81%	73%			
Grad. after more years	89%				
Total graduated	89% (=70)	73% (=63)	66% (=57)		70%
Still enrolled	2	11	14	47	

Average bachelor's performance for cohorts 2006-07 to 2009-10. Continuation after 1 year is 100% (October 2012)

	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Intake	98	96	100	101	100	109
P within 1 year	39%	38%	39%	37%	49%	45%
P within 2 years	58%	54%	62%	63%	61%	
P within 3 years	69%	67%	73%	73%		
P after more years	76%	76%	75%			
Total P	76%	76%	75%			
Still enrolled	-	3	2	6	16	42

Average P (propedeuse) performance over the period 2006-2011 (October 2012)

	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2020 UT target
Intake	98	96	100	101	100	109	
Dropouts within 1 year	19%	10%	14%	13%	20%	18%	
Dropouts within 2 years	23%	18%	24%	24%	26%		
Dropouts within 3 years	26%	19%	27%	24%			
Total dropout	27%	23%	29%	24%			Max.30%
Still enrolled	2	11	14	47			

Cumulative percentages of dropouts per cohort (October 2012)

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Master of Technical Medicine

	2006-2007	2007-2008	2008-2009	2009-2010
Intake	35	37	42	72
Graduated within 3 years	31%	14%	19%	
Graduated within 4 years	74%	65%		
Graduated within 5 years	83%			
Graduated after more years	89%			
Total graduated	**89%**	**65%**		
Still enrolled	-	6		

Average master performance over the period 2006-07 to 2009-10; counted in months from the registration date (October 2012).

	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Intake	35	37	42	72	51	58
Dropouts within 1 year	3%	5%	2%	6%	2%	2%
Dropouts within 2 years	6%	11%	5%	14%	8%	
Dropouts within 3 years	9%	16%	12%	15%		
Total dropout	**11%**	**19%**	**17%**			
Still enrolled	-	6	25	52	46	57

Cumulative percentages of dropouts per cohort (October 2012)

Teacher-student ratio achieved

Bachelor of Clinical Technology

Students : lecturers	39 : 1
Students : lecturers and student assistants	**29 : 1**

Student-lecturer ratio 2011-2012

Master of Technical Medicine

Students : lecturers	16 : 1
Students : lecturers and student assistants	**15 : 1**

Student-lecturer ratio 2011-2012, first year master's programme

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

Bachelor of Clinical Technology

	Quartile 1	Quartile 2	Quartile 3	Quartile 4	**Average**	**UT target 2015**	**Intensive methods**
Bachelor 1	20.7	14.9	18.8	16.6	**17.7**		**58%**
Bachelor 2	21.5	18.2	20.6	11.4	**17.9**		**53%**
Bachelor 3	12.1	14.1	18.0	MDO	**14.7**		**49%**
Average bachelor's programme					**16.8**	**Min. 12 hrs.**	**53%**

Contact time per week; in clock hours

Master of Technical Medicine

M1	Quartile 1	Quartile 2	Quartile 3	Quartile 4	**Average**	**Intensive methods**
MS	15.1	9.7	9.4	10.2	**12.3**	**44%**
R & I	15.1	14.3	17.3	17.6	**16.2**	**63%**
RM	6.4	16.5	9.3	16.5	**16.5**	**55%**
Average of 3 tracks					**15.0**	**54%**

Average contact time per week per track in year 1; in clock hours. Underlined = elective course of 5 EC not included.

Appendix 6: Programme of the site visit

Thursday 11 April 2013

08.45 - 09.00	**Arrival committee**
09.00 - 10.00	**Preparation meeting**; inspection documents
10.00 - 11.30	**Dean / management**
	Prof.dr. Gerard van der Steenhoven - Dean faculty TNW
	Heleen Miedema, MSc - Programme Director
	Prof.dr. René Veth - Medical Director MIRA
	Ineke ten Dam, MSc - Programme Manager
	Ir. Remke Burie, MBA - Head ECTM
11.30 - 12.30	**Bachelor students**
	Kicky van Leeuwen (chair SVC bachelor)
	Judith Dijkstra (Education commissioner Paradoks)
	B1: Mirthe Ketel
	Reneé Geraarts
	B2: Hans-Pieter Snels
	Feline Spijkerboer
	B3: Niels Schurink
12.30 - 13.30	**Lunch** inspection documents; open access consultation hour
13.30 - 14.15	**Lecturers Bachelor programme**
	Dr.ir. Bennie ten Haken
	Prof.dr.ir. Wiendelt Steenbergen
	Prof.dr.ir. Peter Veltink
	Prof.dr.ir. Anton Stoorvogel
	Dr. Carine Doggen
	Dr. Rob de Waal
14.15 - 15.15	**Master students**
	Sander Brinkhof (chair student publicity team)
	Inge Slouwerhof (chair SVC master)
	M1: Jurgen Oude Booijink- MSS
	Wendelien Sanderink- MII
	M2: Erwin Krikken- MII
	Marjolein Admiraal- MSS
	M3: Martijn van Mourik- MSS
	Anique Grob- MII
15.15 - 15.30	**Break**
15.30 - 16.15	**Lecturers and supervisors Master programme**
	Ir. Benno Lansdorp
	Prof.dr.ir. Kees Slump
	Bernard van Driel, MD
	Prof.dr. Daniel Saris
	Prof.dr.ir. Michel van Putten
	Prof.dr. Ivo Broeders
	Dr. Bob Geelkerken
16.15 - 17.00	**Lecturers Professional behaviour and Study advisors**
	Lecturers Professional behaviour:
	Paul van Katwijk, MSc
	Annelies Lovink, MSc
	Nicole Cramer Bornemann, MSc
	Sylvia van Barneveld, MD

	Dr. Marleen Groenier
	Study advisors:
	Marieke Hofman, MSc
	Deirdre Brandwagt, MSc
17.00 - 17.45	**Alumni**
	Martijn van Lavieren, MSc
	Marleen Cloostermans, MSc
	Michelle Heijblom, MSc
	Marleen Molenaar, MSc
	Attending on Skype: Joyce Bomers, Wietske vd Weg

Friday 12 April 2013

08:15 - 08:30	**Arrival committee**
08.30 - 09.00	**Preparation meeting (**committee only)
09.00 - 09.30	**Student members Education Committee**
	Femke Schröder (vice-chair)
	Maaike Braham
	Rob van Doremalen
	Mathilde Hermans
	Annemiek Janssens
09.30 - 10.00	**Education Committee**
	Lecturers:
	Prof.dr.ir. Bart Koopman (chair)
	Dr. Anne-Marie van Cappellen van Walsum
	Annelies Lovink, MSc
	Eline Oppersma, MSc
	Prof.dr.ir. Kees Slump
	Students: see above
10.00 - 10.15	**Break**
10.15 - 11.00	**Examination committees BEX and MEX**
	BEX:
	Dr.ir. Frans de Jongh (chair)
	Nicole Cramer Bornemann, MSc
	MEX:
	Prof.dr.ir. Kees Slump (chair)
	Dr.ir. Aart van Apeldoorn
	Prof.dr. Stephan van Gils
	Paul van Katwijk, MSc
	Selma Kamphuis (secretary BEX/MEX)
11.00 - 11.45	**Visit to lecture rooms and**
	Experimental Centre for Technical Medicine
11.45 - 12.15	**Inspection documents** (committee only)
12.15 - 13.00	**Lunch**
13.00 - 13.45	**Preparation final meeting with management (committee only)**
13.45 - 14.45	**Final meeting with management**
	Prof.dr. Gerard van der Steenhoven - Dean faculty TNW
	Heleen Miedema, MSc - Programme Director
	Prof.dr. René Veth - Medical Director MIRA
	Ineke ten Dam, MSc - Programme Manager
	Ir. Remke Burie, MBA - Head ECTM
14.45 - 16.45	**Preparation preliminary conclusions** (committee only)
16.45 - 17.15	**Presentation of preliminary conclusions**

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:

Bachelor of Clinical Technology

0180033	1021877	1021362	0152072	0203297
0180157	0203173	0179736	0180238	
0201383	1021303	0202142	0203289	
1021362	1021397	0203297	1021303	

Master of Technical Medicine

s0037397	s0099880	s0099716	s0077984	s0156132
s0099910	s0077992	s0127043	s0103292	s0126640
s0100080	s0037427	s0063223	s0099651	

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):

Aanwezige documentatie visitatie TG/TM 10-12 april 2013

BACHELOR vakken		
Meten en Verwerken van Signalen (Measuring and Processing of Signals)	Map	B1
Spijsverteringssysteem (Digestive System)	Map	B2
Epidemiologie/Statistiek/MTA (Epidemiology, Statistics and Medical Technology Assessment)	Map	B3
Blokboeken • Meten en Verwerken van Signalen 2011-2012 • Spijsverteringssysteem 2011-2012 • Epidemiologie/Statistiek/MTA 2011-2012	Blokboek	
MASTER vakken		
Advanced Life Support **MSS/MII**	Map	MSS/MII
Clinical Rotations **MSS/MII**	Map	MSS/MII
Circulation and Ventilation **MSS**	Map	MSS
Reconstruction and Visualization	Map	MII
Injections Punctures and Catheterization	Map	MSS/MII
Surgical Skills	Map	MSS/MII
Endoscopic Skills	Map	MSS/MII
Diversen Onderwijs		
Jaarverslag studieadviseurs Visie document 2011-2012	Map	
Practicum verslagen Spijsverteringssysteem	Verslag	
Keuzegids Hoger onderwijs	Gids	
Overview Academic Staff	Map	
Bachelor en Master evaluaties	Map	
Handboek kwaliteitszorg	Map	

Toetsbeleid	Map	
Trackoverleggen 2011-2012 • MSS/MII • MS/R&I/RM	Map	
Onderwijsoverleg+ MT-klein/groot 2011-2012	Map	
Onderwijsblokken en roosters 2011-2012	Map	
Leerdoelen-vakken matrix bachelor		
Leerdoelen-vakken matrix master		
Slagingspercentages wiskunde vakken bachelor		
Overzicht follow-up aanbevelingen vorige visitatiecommissies		
Commissies		
OLC-TG • 2008-2009 • 2009-2010 • 2010-2011 • 2011-2012 • 2012-2013 BEX-TG • 2008-2009 • 2009-2010 • 2010-2011 • 2011-2012 • 2012-2013 MEX-TG • 2006-2007 • 2007-2008 • 2008-2009 • 2009-2010 • 2010-2011 • 2011-2012 • 2012-2013	Map	
Aanvullende literatuur		
Capaciteitsplan 2010, *Capaciteitsorgaan* Medical Devices: Managing the Mismatch, *World Health Organization* Competentieprofiel: academisch opgeleide TM professionals, *NFU/ 3TU* Risico's van medische technologie onderschat*, staatstoezicht op de gezondheidszorg* Taakherschikking in de gezondheidszorg Voorbehouden handelingen tegen het licht, de regeling van artikel 35-39 wet BIG heroverwogen, *sept. 2009, AMC-UvA, afdeling sociale geneeskunde* Evaluatie wet op de beroepen in de individuele gezondheidszorg. TM The first hundred graduates	Boek	

Paradoks		
SV Paradoks: Almanak 2006-2007; *Pit wordt het nieuws* SV Paradoks: Almanak 2009-2010; *BIG* SV Paradoks: Almanak 2010-2011; *Lekker gewoon gebleven* SV Paradoks: Almanak 2011-2012; *Paranormaal*	Boek	
Parallaks; jaargangen: • 9 nummer 5 • 10 nummer 2 • 11 nummers 1 t/m 6	Tijdschrift	
Final Report: *Breaking boundaries in Biomedical Engineering*	Boek	
Final Report: *Study Tour Japan*		
Final Report: *Serba Boleh;surprising contrasts Study Tour 2011 Malaysia& Singapore*	Boek	
Literatuur Bachelor		
Literatuur • ***Clinically Oriented Anatomy*** Moore K.L. Williams & Wilkins, Baltimore 2006 (6th edition) ISBN: 0781736390 • ***Feneis Geillustreerd zakwoordenboek Latijn,5e druk*** ISBN: 9789031348138 Uitgeverij: Bohn Stafleu van Loghum Verschijningsdatum: 02-10-2010 530 pagina's. Formaat: 60 cm • ***Grant's Atlas of Anatomy*** Agur A.M.R., Lee M.J. Lippincott, Williams & Wilkins, Baltimore 2008 (12th edition) ISBN: 0781770556 • ***Larsen's Human Embryology*** Schoenwolf, G.C., Bleyl, S.B. Elsevier Health 2008 (4rd edition) ISBN: 0443068119 • ***Medische Fysica*** Van Oosterom, A., Oostendorp T.F. Elsevier Gezondheidszorg, Maarssen 2008 (3e editie) ISBN: 9035223535 • ***Thomas' Calculus Early Transcendentals*** George B. Thomas, Jr. , Maurice D. Weir , Joel R. Hass Pearson ISBN 13: 987-0-321-6363-4 • ***Biomaterials Science: An Introduction to Materials in Medicine*** Door Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons Bijdrager Buddy D. Ratner, Allan S. HoffmanGepubliceerd door Academic Press, 2004 ISBN 0125824637, 9780125824637 851 pagina's • ***Essential Cell Biology*** Alberts B. et. al. Garland Publishing Inc., New York 2004 (3rd edition) ISBN: 0815334818		B1/B2/B3

• ***Functionele Histologie*** Junqueira L.C., Carneiro J, Kelly R.O., Elsevier Gezondheidszorg, Maarssen 2007 (11e editie) ISBN: 9035228626 • ***Pathology*** Rubin E. et al., Lippincott, Williams & Wilkins 2007 (5th edition) ISBN: 0781795168 • ***Medical Physiology*** Boulpaep E, Boron W. Saunders/Elsevier 2009 (2nd edition) ISBN: 1416023283 • ***Clinical Medicine*** Kumar P., Clarke M. Saunders 2005 (6th edition) ISBN: 0702027634 • ***Vaardig Communiceren in de Gezondheidszorg/druk 2,*** Silverman et al, LEMMA 2006, ISBN-13: 978-90-59314511 • ***Brody's Human Pharmacology: Molecular to Clinical*** Minneman, K.P., Wecker, L. Mosby 2005 (5th edition) ISBN: 032302869 • ***The Immune system*** Parham, P. Taylor & Francis, New York, 200. (3rd edition) ISBN: 0-8153-4093-1 • ***Handboek Object Georiënteerd Programmeren*** Beurghs J. Van Duuren Media, 2004 (2e editie) ISBN: 9059401174 • ***Physics for Scientists and Engineers with modern Physics*** Giancoli D.C. Prentice Hall 2008 (4th edition) ISBN: 0131495089 • ***Intermediate Physics for Medicine and Biology*** Hobbie, R.K and B. Roth. Springer-Verlag New York Inc. | 4e Editie | februari 2007 ISBN: 038730942X • ***Epidemiologisch onderzoek, opzet en interpretatie*** Bouter, L.M., Van Dongen, M.C.J.M. Bohn, Stafleu & Van Loghem, Houten (6e herziene druk 2010) ISBN 978 90 313 7813 5 • ***Essentials of Neurophysiology*** Basic Concepts and Clinical Applications for Scientists and Engineers, Michel van Putten, Springer; 1th edition (April 1, 2009) ISBN 3540698892 • ***Clinical Neuroanatomy*** FitzGerald M.J.T., Folan-Curran J., Uitgever: W. B. Saunders, ISBN 0702025585 2006 (6e editie) • ***Patiëntgericht Communiceren,*** *Gids voor de Medische Praktijk. De Tijdstroom 2010* *ISBN: 9789058981806* • ***Medische psychologie*** *Kaptein A. A., et al. Bohn, Stafleu en Van Lochem 2006* *ISBN: 9031344621* • ***Anamnese en Lichamelijk Onderzoek*** *Van der Meer, J., Van 't Laar, A. Elsevier Gezondheidszorg, Maarssen 2006 (5e editie) ISBN: 9035228715* • ***Emery's Elements fo Medical Genetics*** 14th ed		

Peter Turnpenny & Sian Ellard Elsevier ISBN: 9780702029172 • ***Ethiek in Praktijk*** *Bolt, L.L.E., Verweij, M.F., Delden, J. Van Gorcum 2007 (6e druk)* *ISBN: 9023238354*		
Literatuur Master		
Literatuur • Micheal C.K. Khoo, Physiological Control Systems - Analysis, Simulation, and Estimation, IEEE Press Series on Biomedical Engineering, ISBN 0-7803-3408-6 (students do not need to buy this book, it is available at Technical Medicine) • John G. Webster, Medical Instrumentation, Application and Design, Wiley 1998, ISBN: 0-471-15368-0 (voorkeur) Of boek: John Enderle et al., Introduction to Biomedical Engineering, Elsevier, 2005, ISBN: 0-12-238662-0 (indien reeds in bezit) • Eugene M. Izhikevich. Dynamical systems in Neuroscience: The geometry of Excitability and Bursting. The MIT Press, 2007 • Inleiding tot de stralingshygiëne' van A.J.J. Bos • John J. Craig. Introduction to Robotics Mechanics and Control (Third Edition). Prentice Hall, 2005. • Pathology, Rubin E. et al, Lippincott, Williams& Wilkins 2007, 5th edition, ISBN 0781795168 • Textbook Tissue Engineering, Clemens van Blitterswijk, Academic Press 2008 • Tissue Engineering. Clemens van Blitterswijk. Academic Press. 2008 • Zebrareeks	MS/R&I/RM	

Appendix 8: Declarations of independence

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: H.F.P. Hillen

ADRES: NA

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

Bachelor in Clinical Technology
Master in Technical Medicine

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

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;

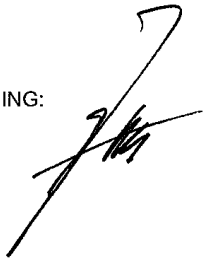
VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

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

PLAATS: Enschede

DATUM: 11 April 2013

HANDTEKENING:



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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: R. P. Zwierstra

ADRES: NA

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

Bachelor in Clinical Technology
Master in Technical Medicine

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

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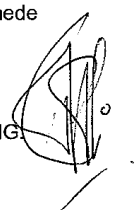
VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

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: Enschede DATUM: 11 April 2013

HANDTEKENING:



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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE Jos NIESSEN.

NAAM:

ADRES: NA

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

Bachelor in Clinical Technology
Master in Technical Medicine

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

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;

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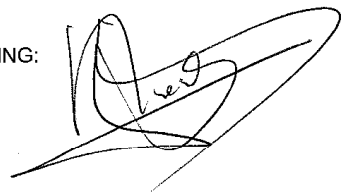
VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Enschede DATUM: 11 April 2013

HANDTEKENING: 

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: RAJIV GUPTA, MD, PhD

ADRES: NA

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

Bachelor in Clinical Technology
Master in Technical Medicine

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

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;

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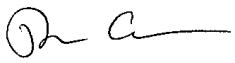
PLAATS: Enschede DATUM: 11 April 2013

HANDTEKENING: 

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Prof. Dr. A.F.P.M. de Grave

ADRES: NA

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

Bachelor in Clinical Technology
Master in Technical Medicine

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

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;

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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: Enschede DATUM: 11 April 2013

HANDTEKENING: 

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE ...

NAAM: Jort Kroptf.

ADRES: NA

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

Bachelor in Clinical Technology
Master in Technical Medicine

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

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;

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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: Enschede DATUM: 11 April 2013

HANDTEKENING: 

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Hugo Verkerke

ADRES: NA

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

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

PLAATS: Enschede DATUM: 11 April 2013

HANDTEKENING:

2

Appendix 9: Recommendations

The committee has made the following recommendations:

- In order to further develop and specify its profile and intended learning outcomes, the visitation panel advises the programme to make an international benchmark with comparable programmes at other universities.
- Regarding the intended learning outcomes of the Master programme, level III is sufficient for all reserved procedures for graduates to fulfil their professional role.
- The visitation committee would like to see the introduction of electives in the Bachelor programme.
- The share of humanities and molecular and cell biology should increase in both the Bachelor and the Master programme.
- The visitation committee recommends that the didactical concept underlying both programmes should be made more explicit.
- It should be investigated which measures can be taken to reduce the workload of the teaching staff.
- Steps should be taken to reduce the student dropout rate after the first year in the Bachelor programme and in the Master programme.
- The evaluation of test results should be implemented more structurally in the assessment policy.