Assessment report
Limited Programme Assessment

Bachelor Nanobiology (joint degree)

Delft University of Technology and Erasmus University Rotterdam

Contents of the report

1. Executive summary

In this executive summary, the panel presents the main considerations that led to the assessment of the quality of the Bachelor programme Nanobiology of the Delft University of Technology and Erasmus University Rotterdam, which has been assessed according to the NVAO Assessment Framework.

The panel noted that programme management followed up on the recommendations, made during the initial programme assessment in 2012. Programme management, among others, has taken measures to improve the information to prospective students and to adjust the curriculum. The panel is convinced the programme is monitored in a process of continuous improvement.

The cooperation agreement drafted by Delft University of Technology and Erasmus University Rotterdam adequately describes the responsibilities of these two institutions and provides satisfactory assurances for the quality of the programme.

The panel supports the objectives of the programme to study and understand molecular or cellular biology phenomena by means of concepts and methods of mathematics and physics. The panel is positive about the clear choices programme management made in this respect and feels the programme has added value to both of the partner institutions. The panel acknowledges the specific profile of the programme.

The programme primarily prepares students for master programmes in this and related fields. In the future, not all students may find positions in the academic world. The panel recommends programme management to intensify the relations to the professional field to make sure that the programme also fits well to the needs of the professional fields and to help students find positions there.

The learning outcomes of the programme meet the programme objectives, are related to international concepts in this field and meet the requirements of an academic bachelor programme. The panel advises to mention chemistry more explicitly in the learning outcomes, as this is an important discipline in this field. The panel also suggests to include ethics or ethical awareness in the learning outcomes.

The panel considers the admission requirements to be in line with legal regulations and the admission procedures to be effective in informing the applicants about the challenging nature of the programme. The panel supports the *numerus fixus* decision, as the practical part of the programme would otherwise suffer.

The curriculum meets the intended learning outcomes. The panel is very positive about the curriculum, especially because of the intimate connection to current research in this field. In addition, the panel is very pleased with the curriculum design, displaying logical structure and strong coherence. The courses in the first year primarily offer students disciplinary knowledge and understanding in the constituent disciplines. In the second year, focus is on interdisciplinary and integrating courses. In the third year, students are given the opportunity to prepare for the master programme of their preference and to specialise within the field of nanobiology. The panel welcomes the bridge courses and is very confident that these courses will be further optimised.

The educational principles to promote students actively engaging in their studies and taking responsibility for their learning processes were confirmed both by programme management and lecturers. The study methods are consistent with these educational principles. The panel regards the study load and study guidance in the programme to be appropriate. The bilocation presents no problems for the teaching.

In addition, the panel regards the laboratories of Rotterdam University of Applied Sciences to provide good facilities for the practical work in the programme.

The lecturers are renowned researchers in their field, ensuring research to be strongly represented in the programme. The panel observed the lecturers identifying themselves not only with their own courses, but also with the programme as a whole, adding to the coherence of the curriculum. Lecturers meet regularly. As the proportion of lecturers with the UTQ-certificate is quite low, the panel advises raising this number. The program is taught in English. Both lecturers and students indicate that this is working well. The panel suggests to introduce formal requirements for proficiency in English for the lecturers of Erasmus Medical Center (as is currently the case at Delft University of Technology).

The examination and assessment rules and regulations of the programme meet the Assessment System of the Faculty of Applied Sciences of Delft University of Technology, providing a solid basis. These rules and regulations include peer-review among lecturers in preparing examinations, drafting test matrices, selecting appropriate examination methods, inspecting the outcomes of examinations in case of abnormal grade distributions and verifying the quality of the projects and of the assessments thereof. The panel advises to refrain from communicating examination outcomes and to investigate the examination first, if the grade distribution would be abnormal

The Board of Examiners monitors the examination and assessment processes and outcomes adequately. The panel is positive about the active approach this Board is taking, meeting every two years with every one of the lecturers to discuss a number of important topics in this respect.

The examination methods conform to the course contents. Having multiple examinations in the courses allows to assess students' performances on different dimensions, relevant for the courses. The panel considers the processes of supervision and assessment for the *Bachelor End Projects* to be appropriate. The supervision during the project is sufficiently intensive. The assessment by two examiners, using rubrics scoring models leads to reliable assessments.

The panel assesses the examinations to be satisfactory in breadth and depth and to reflect the learning goals of the courses. The panel agrees with the grades awarded by the programme examiners for the *Bachelor End Projects*. The panel noted that these grades are relatively high. As this concerns the first group of students graduating in a short period of time, this group may include relatively many very good students. From the master programmes the graduates have been admitted to, the panel deducts the students to have been well educated and to have ample opportunities to continue their studies in a wide array of disciplines.

The panel assesses the Bachelor programme Nanobiology of Delft University of Technology and Erasmus University Rotterdam to be satisfactory and recommends NVAO to grant re-accreditation to this programme.

Rotterdam, 12 April 2017

Prof. dr. ir. E.J.G. Peterman
(panel chair)

drs. W. Vercouteren RC
(panel secretary)

2. Assessment process

Certiked VBI received a request to conduct a limited programme assessment for the re-accreditation of the Bachelor programme Nanobiology. This request was submitted by the Delft University of Technology and Erasmus University Rotterdam.

Certiked requested the approval by NVAO of the proposed panel of experts to conduct this assessment. NVAO have given its approval. The panel composition was as follows (for more detailed information please refer to Annex 4: Composition of the assessment panel):

- Prof. dr. ir. E.J.G. Peterman, full professor Physics of Living Systems, Vrije Universiteit Amsterdam (panel chair);
- Prof. dr. ir. M.M.A.E. Claessens, full professor Nanobiophysics, University of Twente (panel member);
- Prof. dr. J.A.E. Eggermont, full professor Cell Physiology. KU Leuven (panel member);
- J.C. van Campenhout LLB, student pre-master programme Law, Tilburg University (student member).

On behalf of Certiked, drs. W. Vercouteren RC was responsible for the process coordination and for drafting the panel's report. All panel members and the secretary signed a statement of independence and confidentiality.

The panel conducted this assessment on the basis of the standards of the NVAO Assessment Framework of 19 December 2014 (Staatscourant nr. 36791).

The following procedure was adopted. The panel members studied the documents presented beforehand by programme management, including a number of final products of the students or theses (please refer to Annex 2 and 3: Documents studied and Final products reviewed). With respect to the selection and study of the theses, the panel proceeded in line with the NVAO Guidelines for the assessment of final projects during external assessments of 18 February 2015.

Before the date of the site visit, the panel chair and the panel secretary met to discuss the assessment procedures. Before the site visit date, all panel members sent in their preliminary findings, based on the information file submitted by programme management, a number of questions to be put to the programme representatives on the day of the site visit and their findings about the theses, they had studied. The panel secretary summarized this information and drafted a list of questions, which served as a starting point for the discussions with the programme representatives during the site visit.

On 7 March 2017, the panel had a meeting to discuss the preliminary findings concerning the quality of the programme. During this preliminary meeting, the findings of the panel members were discussed, including these pertaining to the theses.

On 8 March 2017, the panel conducted a site visit on the Delft University of Technology campus. The site visit schedule was in accordance with the schedule drafted beforehand (please refer to Annex 1: Site visit schedule). Programme management communicated the open office hours to the students and staff of the programme. No persons called on the panel.

In the closed session at the end of the site visit, the panel members considered the findings, weighed the considerations and drew conclusions regarding the quality of the programme. At the end of the site visit, the panel chair presented the findings to programme management in broad outline.

A draft version of this report was finalised by the secretary, having taken into account the information presented as well as the findings and considerations of the panel. The draft report was sent to the panel members, who studied the draft report and made a number of changes. Thereupon, the secretary edited the final report. This report was presented to programme management to be corrected for factual inaccuracies. After having been corrected for these inaccuracies, the report was sent to the institution's Board to accompany their request for re-accreditation of this programme.

3. Overview of the programme

3.1 Basic information about the programme

Administrative information about the programme

Name programme in CROHO: B Nanobiology (joint degree)
Orientation, level programme: Academic Bachelor
Grade: BSc
Number of credits: 180 EC
Specialisations: N.A.
Location: Delft, Rotterdam
Mode of study: Full-time
Registration in CROHO: 55003

Administrative information about the institution

Name of institution: Delft University of Technology and Erasmus University Rotterdam
Status of institution: Government-funded Universities
Institutions' quality assurance: Approved

Quantitative data about the programme

Since the programme is offered only since 2012, the quantitative data about the programme are limited.

Percentage of students who dropped out after one, two or three years (vwo matriculation)

Cohort	2012	2013	2014	2015
Drop-out rate after one year	28 %	28 %	19 %	15 %
Drop-out rate after two years				
Drop-out rate after three years				

Percentage of students who continued their study in the second year and who completed the programme after three, four, five and six or more years (vwo matriculation)

Cohort	2012	2013	2014	2015
Success rate after three years	50 %	33 %		
Success rate after four years	75 %			
Success rate after five years				
Success rate after six or more years				

Lecturers' qualifications

Qualification	MSc	PhD	UTQ
Percentage of lecturers	100 %	90 %	38 %

*UTQ means having obtained the University Teaching Qualification.

The student-to-staff ratio is 20 : 1.

Number of contact hours per week for each of the years of the programme

Year of the programme	Year 1	Year 2	Year 3
Number of contact hours per week	23.0	25.5	30.0

3.2 Main facts about the institutions

The Bachelor programme Nanobiology is a joint degree programme of the Faculty of Applied Sciences of Delft University of Technology and the Erasmus Medical Center of Erasmus University Rotterdam.

According to the Delft University of Technology website, the University's mission statement is to make a significant contribution towards the sustainable society for the twenty-first century by conducting ground-breaking and world-class scientific and technological research, by training scientists and engineers with genuine commitment to society and by helping to translate knowledge into technological innovations and activity with both economic and social value. The Delft University of Technology wants to remain a technology university with a leading global reputation. To do this, the University's aim is to maintain a full range of high-quality disciplines, courses and unique facilities in the engineering sciences. The Delft University of Technology comprises eight faculties, being the Faculties of Aerospace Engineering, Applied Sciences, Architecture and the Built Environment, Civil Engineering and Geosciences, Electrical Engineering, Mathematics and Computer Science, Industrial Design Engineering, Mechanical, Maritime and Materials Engineering and Technology, Policy and Management. These faculties offer 16 bachelor programmes and 30 master programmes. About 21,000 students study at the Delft University of Technology and about 5,000 staff are employed by the University.

In its own words, Erasmus University Rotterdam is a research University, with a pronounced social orientation in its education and research. Academics and students at the university are expected to endeavour to solve global social challenges, drawing inspiration from the metropolis Rotterdam. The university spearheads in education and research are health (from molecule to human to society and back), wealth (sustainable economic growth), governance (the organisation of companies and society) and culture (happiness and identity in the modern urban society). Erasmus University Rotterdam is composed of seven faculties, these being Erasmus School of Economics, Erasmus School of Law, Faculty of Social Sciences, Erasmus Medical Centre, Faculty of Philosophy, Erasmus School of History, Culture and Communication and Rotterdam School of Management. In addition, the university includes the Institute of Health Policy & Management, the International Institute of Social Studies and the Institute for Housing and Urban Development Studies. Erasmus University Rotterdam employs more than 2,700 staff, lecturers as well as support staff. Over 26,000 students study at this University.

3.3 Intended learning outcomes

The intended learning outcomes of the programme are as follows. The graduates of the programme are expected:

- To demonstrably possess relevant (fundamental and current) knowledge of mathematics (analysis/calculus, linear algebra, transformations, differential equations, statistics), physics (mechanics, vibrations, waves, optics, heat theory, relativity, quantum mechanics, thermodynamics), biology (molecular biology, genetics, evolution, development) and methods and techniques of applied scientific research, such as scientific philosophy, research methodology, model formation and the formulation of a research question.
- To be able to identify related concepts in biology and physics and to apply knowledge of one field of science to another.
- To be able to use the acquired knowledge to follow current scientific research in the fields of biology and biophysics intensively, in addition to understanding and interpreting the academic literature in these fields.

- To have demonstrable experimental research skills in the fields of molecular biology and biophysics, such as: mastery of common experimental methods, the formulation of hypotheses, the identification of methods for testing hypotheses, the collection and critical assessment of academic literature, the processing of experimental data (interpretation, analysis and evaluation).
- To have the required communication skills with which they: will be able to convey scientific knowledge and ideas to an audience of fellow students, both in writing and orally and will be able to contribute to discussions on the value of fundamental scientific research to society and the social responsibility of a researcher.
- To be aware of the need for lifelong learning and of the utility of creativity to the achievement of scientific progress.

3.4 Outline of the curriculum

In the table below, the programme curriculum has been presented.

Curriculum components	Credits
Genetics	4 EC
Introduction to study nanobiology	3 EC
Analysis 1	5 EC
Chemistry 1	3 EC
Physics 1a	4 EC
Chemistry 2	3 EC
Analysis 2	5 EC
Biomolecular Dynamics	3 EC
Physics 1b	3 EC
Labcourse Nanobiology 1	3 EC
Biomolecular Dynamics	3 EC
Biophysics	3 EC
Journal Club	3 EC
Biomolecular Programming	3 EC
Physical Biology of the Cell	3 EC
Labcourse Nanobiology 2	3 EC
Linear Algebra	3 EC
Analysis 3	3 EC
First year	60 EC
Physical Biology of the Cell	3 EC
Physics 2	3 EC
Electronic Instrumentation	6 EC
Differential Equations	3 EC
Thermodynamics and Transport	3 EC
Signals and Systems	6 EC
Evolutionary & Developmental Biology	6 EC
Statistics	3 EC
Philosophy and Ethics	3 EC
Microscopy/Nanoscopy	1.5 EC
Computational Science	1.5 EC

Optics and Microscopy	3 EC
Evolution	3 EC
Statistical Physics	3 EC
Bioinformatics	4.5 EC
Nanotechnology	2 EC
Image Analysis	3 EC
Journal Club	1 EC
Computational Science	1.5 EC
Second year	60 EC
Minor	30 EC
Bachelor End Project	20 EC
Electives	10 EC
Third year	60 EC
Programme	180 EC

4. Overview of assessments

Standard	**Assessment**
Standard 1. Intended learning outcomes	Satisfactory
Standard 2: Teaching-learning environment	Good
Standard 3: Assessment	Satisfactory
Standard 4: Achieved learning outcomes	Satisfactory
Programme	Satisfactory

5. Findings, considerations and assessments per standard

5.1 Standard 1: Intended learning outcomes

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

Findings
The programme Bachelor Nanobiology was offered for the first time in 2012. The programme is a joint degree programme of the Faculty of Applied Sciences of Delft University of Technology and the Faculty of Medical Sciences or Erasmus Medical Center of Erasmus University Rotterdam. The two participating universities drafted a cooperation agreement with respect to design and delivery of this programme.

The scientific field of nanobiology studies the interaction between molecules, cells and organisms from the physics perspective. Principles, concepts and methods of physics and mathematics are applied to phenomena of (medical) biology in order to better understand these phenomena.

The objectives of the Bachelor Nanobiology programme are to train students in the fields of mathematics, physics and biology and to provide them with knowledge and skills to study biological phenomena through mathematics and physics concepts and methods. In the words of programme management, the objectives of the programme are to provide students with fundamental knowledge of mathematics, physics and biology, to educate them to understand and describe the complexity of molecular, cellular, evolutionary and developmental biology in terms of mathematics and physics and to train them to apply mathematics and physics methods and concepts to biological phenomena.

In the programme, students are primarily educated to enter master programmes in this and related fields. The programme offered is directed towards fundamental scientific research in this field. Findings may, on the other hand, be applied specifically to subjects and problems of human health and disease.

No domain-specific framework of reference for the programme is available. Programme management, therefore, drafted the domain-specific framework for the programme themselves, especially referring to the subject benchmark statements for fundamental physics and molecular biology of the Quality Assurance Agency for Higher Education in the United Kingdom. These benchmark statements served as input to draft the intended learning outcomes of the programme.

Although no other bachelor programmes in nanobiology are offered in the Netherlands, there are comparable programmes that bridge physics and/or chemistry with biology and biomedical sciences, offered, among, others at Radboud University, Utrecht University and Wageningen University (Molecular Life Sciences) or Vrije Universiteit (Medical Natural Sciences). Compared to these programmes, this Bachelor Nanobiology programme may be said to distinguish itself by the strong emphasis on quantitative methods of mathematics and physics to study and understand cellular and molecular biological phenomena. Outside of the Netherlands, no programmes at bachelor level in this field are offered.

Programme management drafted the list of intended learning outcomes for the programme (please refer to section 3.3 for this list). These learning outcomes require students to acquire fundamental knowledge of the constituent disciplines mathematics, physics and biology, to be able to bridge physics and biology, to know current scientific research in these disciplines, to obtain research skills, to acquire communication skills and the know how to accomplish life-long learning.

In addition, programme management presented a table and explanatory text to demonstrate the intended learning outcomes of the programme to meet the Dublin descriptors for the bachelor level.

Considerations
The panel studied the cooperation agreement drafted by Delft University of Technology and Erasmus University Rotterdam and considers this agreement to adequately describe the responsibilities of these two institutions and the division of tasks between them concerning the delivery of this programme. The panel is of the opinion this agreement provides satisfactory assurances for the quality of the programme.

The panel supports the objectives of the programme to study principles, concepts and methods of physics and mathematics in the context of biology and to understand molecular, cellular, developmental, and evolutionary biology phenomena from quantitative mathematical and physics perspectives. The panel feels the programme has added value to both of the joint degree partner institutions. In addition, the panel is positive about the clear choices programme management made to focus on quantitative methods to study biology. It is clear to the panel the programme is not primarily meant to train students to enter the labour market, but to prepare them for master programme in this and closely related fields.

Respecting the fundamental research profile of the programme, in the future not all of the students may find positions in the academic world. The range of prospective positions for students may come to include positions in the professional field. Therefore, the panel recommends programme management to intensify the relations to the professional field.

The panel appreciates the objectives and intended learning outcomes of the programme to be related to international concepts in this field by linking these to the internationally renowned Quality Assurance Agency for Higher Education benchmark statements.

The panel welcomes the comparison to other bachelor programmes in this field in the Netherlands. Although the panel acknowledges the specific profile of the programme, other programmes in the Netherlands have as their objectives to bridge physics, chemistry and (medical) biology on the molecular, cellular and organism level.

In the panel’s opinion, the intended learning outcomes of the programme meet the programme objectives. These intended learning outcomes reflect, among others, understanding, knowledge and skills in the constituent disciplines of the programme, bridging these disciplines and research skills. The panel recommends to mention chemistry more explicitly in the learning outcomes, as this is an important discipline in the programme field. In addition, the panel suggests to include ethics and ethical awareness in the programme intended learning outcomes. The panel ascertained the learning outcomes of the programme comply with the Dublin descriptors for bachelor programmes and, therefore, to meet the requirements of an academic bachelor programme.

Assessment of this standard
These considerations have led the assessment panel to assess standard 1, *Intended learning outcomes*, to be satisfactory.

5.2 Standard 2: Teaching-learning environment

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

Findings
The programme is managed by the director of studies at Erasmus Medical Center and the programme coordinator at Faculty of Applied Sciences of Delft University of Technology. The programme Board of Studies, being composed of lecturers and students in the programme, advises programme management on quality issues. The examinations and assessments in the programme are monitored by the programme Board of Examiners, which is a sub-committee of the Faculty of Applied Sciences-wide Board of Examiners of Delft University of Technology.

The number of students enrolling in the programme increased substantially over the years, going from the influx of 73 students in 2012 to an influx of 134 students in 2016. Equal proportions of male and female students enrol in the programme. The vast majority of the students have as their previous education the Dutch *vwo-diploma*.

The entry requirements for students are the Dutch diploma pre-university education (in Dutch: *vwo*), with either the Science & Engineering specialisation with Biology or the Science & Health specialisation with Mathematics B and Physics. Students with different backgrounds are to have an equivalent diploma and are only admitted upon approval by the programme director.

In 2017, programme management imposed a limit on the number of incoming students, introducing the *numerus fixus* on the influx of 100 students per year. The main reason for this is that the facilities for the practical work available to the programme cannot accommodate many more students. Students will be selected on the basis of their scores on the BMAT-test, their high school grades in mathematics, physics and biology, and a nanobiology-related assignment. The *numerus fixus* will be evaluated by programme management within three years from now.

In the first few years of the programme, the proportion of positive binding study recommendations (in Dutch: BSA), implying students having collected the required 45 EC in the first year were disappointing. Programme management has taken measures to raise this number. Measures were, among others, to involve students already studying in the programme to assist in informing applicants. The proportion of positive binding study recommendations rose from 44 % for the 2013-cohort to 62 % for the 2016-cohort. Programme management intends to raise this figure further.

Programme management presented a table in the self-assessment report in which the relations between the intended learning outcomes on the one side and the curriculum components on the other side were specified. From this table, it can be deduced that all of the intended learning outcomes are addressed in the curriculum.

All of the courses in the first year of the curriculum have been especially designed for this programme. The courses in the second year will follow in the next two years (up to now, some of the courses have been given jointly to applied physics and nanobiology students). The mathematics courses, which are taught by lecturers from the mathematics department of Delft University of Technology, are tailored to the nanobiology programme as well. The curriculum consists on the one hand of disciplinary courses in mathematics, physics, chemistry and biology and on the other hand of bridge courses, being courses relating and integrating these disciplines. Chemistry is offered in two distinct courses in the first part of the first year and integrated in courses in the latter part of the first year and in the second year. Teaching the interdisciplinary parts of the curriculum is not straightforward and quite challenging. Programme management has taken a number of measures to try and do this successfully. Lecturers work together in designing "bridge" courses (which are explicitly meant to bridge disciplines), lecturers teach in each others' courses and students are presented interdisciplinary assignments. A number of courses are especially meant to teach students practical skills, such as the *Labcourses Nanobiology* in the first year. Students are also taught computer programming skills in a number of courses. Research skills, academic skills, such as writing, working in groups and presenting, academic conduct and scientific ethics are integrated in the courses. The first two years of the curriculum are composed entirely of compulsory courses. In the third year, no compulsory courses are scheduled. In this year, students select a minor of 30 EC to tailor the curriculum to their individual interests, are given the opportunity to take a number of electives and complete their *Bachelor End Project*. In the minor and in the elective courses, students may prepare for the master programme of their choice. Students are offered the opportunity to take the Honours programme, consisting of an additional 20 EC in the second and third year of the programme. About 10 % of the students participate in this programme. The students with whom the panel met, expressed the curriculum to meet their expectations.

The educational principle of the programme is primarily destined to support academic research-oriented education. Students are trained to be scientists and are taught to participate in the research fields, inherent to this programme. Students are offered content-rich classes and are stimulated to be active in class and to take responsibility for their learning processes. The students with whom the panel met, confirmed this. Study methods include lectures, tutorials, presentations and reporting and practical lab work. The language of instruction in the programme is English.

Programme management has the intention to promote students completing the programme within the time schedule set. When students experience problems in their studies, they may turn to the academic counsellor. In the first year, the academic counsellor for the programme meets with students, who are likely to obtain negative BSA-scores and drafts improvement plans with them. Students in the first year are assigned to mentor groups of about ten students with a senior student as a mentor. Students whom the panel met with, were content about the study guidance. The student success rate for study completion within four years was 75 % for the first cohort. This is close to the 80 %-target. Programme management intends to take measures to attain this target.

The teaching staff amounts to no less than 44 lecturers. More than 90 % of them lecturers obtained a PhD and are active researchers in their fields of expertise. Lecturers from Delft and Rotterdam meet and discuss the programme annually. Meetings between lecturers have intensified the last years, leading to joint lecturing and to joint research. About 38 % of the lecturers obtained the Dutch University Teaching Qualification. An additional 50 % is in the process of acquiring the UTQ-certificate.

Lecture days are either scheduled in Delft or in Rotterdam but not in two places on one and the same day. Programme management, lecturers and students informed the panel experiencing the bilocation as no problem. For their practical work and laboratory teaching, students may make use of the facilities of Rotterdam University of Applied Sciences. Programme management and lecturers informed the panel to maintain very good contacts with this institution, the laboratories and the instructors, describing the facilities and the instructors as being very good. Practical work is monitored by the lecturers of the courses.

Considerations
The panel considers the admission requirements to be in line with legal regulations. In the panel's view, the admission procedures of the programme are elaborate and effective in informing the applicants about the challenging nature of the programme. The panel supports the *numerus fixus* decision, as the practical part of the programme would otherwise suffer.

The panel observed the curriculum to meet the intended learning outcomes. The panel is very positive about the curriculum, especially because of the very intimate connection to current research in this field. In addition, the panel is very pleased with the design of the curriculum, displaying clear built-up and strong coherence, the courses in the first year primarily offering students disciplinary knowledge and understanding in the constituent disciplines, the second year ensuring interdisciplinary and integrating courses and the third year giving students the opportunity to prepare for the master programme of their preference. The panel welcomes the bridge courses and is very confident about the further optimisation of these courses.

Programme management and lecturers both confirmed to promote students to actively engage in their studies and to take responsibility for their learning processes. The panel regards the study guidance in the programme to be appropriate. Study load problems, if they arise, are solved adequately in the programme.

The lecturers are renowned researchers in their field, ensuring research to be strongly represented in the programme. The panel observed the lecturers identifying themselves not only with their own courses, but also with the programme as a whole, adding to the coherence of the curriculum. Lecturers meet regularly. As the proportion of lecturers with the UTQ-certificate is quite low, the panel recommends raising this number. The programme being taught in English causes no problems for students, nor for lecturers. As the panel noted there are no formal requirements for English proficiency for the lecturers of Erasmus Medical Center, the panel recommends to introduce these requirements, as is currently the case for Delft University of Technology lecturers.

The panel observed the bilocation to present no problems for the teaching in the programme. In addition, the panel regards the laboratories of Rotterdam University of Applied Sciences to provide good facilities for the practical work in the programme.

Assessment of this standard
These considerations have led the assessment panel to assess standard 2, *Teaching-learning environment*, to be good.

5.3 Standard 3: Assessment

The programme has an adequate assessment system in place.

Findings
The examination and assessment policy for this programme are in line with the Assessment System of the Faculty of Applied Sciences of Delft University of Technology. The main purposes of this policy are to ensure the examinations and assessments to conform to the intended learning outcomes of the programme and to assure the validity, reliability and transparency of the examinations and assessments.

For the Faculty of Applied Sciences as a whole, the Board of Examiners is responsible for monitoring the examinations and assessments processes and outcomes. As has been indicated, the sub-board for this programme of the Board of Examiners (which also consists of members of Erasmus Medical Center) takes care of these tasks for this programme. The chair of this sub-board is a member of the faculty-wide board.

Each of the courses is assessed by means of multiple examinations, these being, among others, written examinations, assignments, projects and problem sets. The final grade for each of these courses is the weighted average of the constituent examinations.

The rules and regulations for the programme, as drafted by programme management and monitored by the Board of Examiners (please read as sub-board for this programme) include a number of specific measures. Each of the examinations is drafted by one of the lecturers and is subsequently presented to an experienced colleague for peer-review. Lecturers are required to present the test matrix to demonstrate the correspondence between the items in the examination and the course learning goals. Lecturers are to present an appropriate set of examination methods for the courses. Oral examinations are evaluated by two examiners. The Board of Examiners conducts every two years interviews with every one of the lecturers to discuss these subjects. In addition, this Board inspects examination grade distributions to see if the outcomes deviate from the normal distribution. Also, the Board takes samples of *Bachelor End Projects* and re-assesses these projects to verify the quality of the projects and of the assessments.

In the *Journal Club* courses, students get insight in possible topics and research groups for their *Bachelor End Project*. Students are intensively guided in this project by their supervisor. Supervisors are mentioned on a list, approved by programme management. During the process, students are given feedback by their supervisors. The assessment of the *Bachelor End Project* is the responsibility of two examiners, the project supervisor and an independent examiner, coming from another department. The components to be assessed are lab work, written report or thesis and presentation or defence. The distribution of weights across the three components is not entirely fixed. The examiners may adjust this distribution for the specific project. For the assessment of the projects, the examiners make use of a rubrics scoring model. If these two examiners cannot agree on the final grade, a third examiner will be called in.

Considerations
The panel observed the examination and assessment rules and regulations of the programme to meet the Assessment System of the Faculty of Applied Sciences. The panel considers this to provide a solid basis for these rules and regulations. The measures that have been taken in this respect include peer-review among lecturers in preparing examinations, drafting test matrices, selecting appropriate examination methods, inspecting the outcomes of examinations in case of abnormal grade distributions and verifying the quality of the projects and the assessments thereof. The panel advises to refrain from communicating examination outcomes and to investigate the examination first, if the grade distribution would be abnormal.

The Board of Examiners monitors the examination and assessment processes and outcomes adequately. The panel is positive about the active approach this Board is taking, meeting every two years with every one of the lecturers to discuss examination and assessment-related topics.

The panel approves of the examination methods. They are in line with the course contents. Having the courses assessed by multiple examinations allows to judge students' performances on different dimensions, relevant for the courses.

The panel considers the processes of supervision and assessment for the *Bachelor End Projects* to be appropriate. During the project students are intensively supervised on a one-to-one basis by their supervisor. The assessment by two examiners, using rubrics scoring models leads to reliable assessments.

Assessment of this standard
The considerations have led the assessment panel to assess standard 3, *Assessment*, to be satisfactory.

5.4 Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings
The panel studied the examinations of a number of courses in the programme.

In the *Bachelor End Projects*, all the intended learning outcomes of the programme are addressed and the students are to demonstrate in these projects to master these learning outcomes. The average grade of the most recent 30 projects was a little over 8.0. The panel studied a total of fifteen *Bachelor End Projects*.

As has been indicated, the primary objective of the programme is to prepare students to continue their studies at master level, and not so much for them to enter the labour market. The number of graduates of the programme is still limited, given that the programme was launched in 2012. Students and graduates of the programme informed the panel they have or had been given access to master programmes Artificial Intelligence, Nanobiology, Molecular Medicine, Immunology or Physics of Delft University of Technology, Erasmus University Rotterdam or other universities in the Netherlands.

Considerations
Having studied the examinations of a number of courses, which programme management presented, the panel concludes these examinations to be satisfactory in breadth and depth and to reflect the learning goals of the courses.

The panel agrees with the grades awarded by the programme examiners for the *Bachelor End Projects*. The panel noted these grades to be relatively high. This concerns the first group of students, graduating in a short period of time. So, this group may include relatively many very good students.

From the variety of master programmes the graduates have been admitted to, the panel deduces that the students have been well educated and to have ample opportunities to continue their studies in a wide array of disciplines.

Assessment of this standard
The considerations have led the assessment panel to assess standard 4, *Achieved learning outcomes*, to be satisfactory.

6. Recommendations

In this report, several recommendation have been listed. For the sake of clarity, these have been brought together below. The recommendations are the following.

- To intensify the relations of the programme with the professional field to allow students to find positions outside of the academic world.
- To mention chemistry more explicitly as a major constituent discipline in the intended learning outcomes of the programme.
- To add ethics or ethical awareness to the intended learning outcomes of the programme.
- To raise the proportion of lecturers having obtained the UTQ-certificate, as this proportion is now quite low.
- To introduce formal requirements for English proficiency for the lecturers of Erasmus Medical Center.
- To withhold communicating the outcome of examinations and to investigate the examination first, if the distribution of grades would be abnormal.

Annex 1: Site visit schedule

The site visit took place at the Delft University of Technology campus on 8 March 2017. The site visit schedule was as follows.

08.30 h. – 09.20 h.	Arrival and deliberations panel (closed session)
09.20 h. – 10.00 h.	Dean and programme management Prof. dr. ir. J.L. Kloosterman (director of Education, Faculty of Applied Sciences, Delft University of Technology), prof. dr. C. Wyman (programme director Nanobiology)
10.00 h. – 11.20 h.	Programme management and core lecturers Prof. dr. C. Wyman (programme director Nanobiology), T. Hilkhuijsen MSc (academic counsellor), prof. dr. R. Kanaar (lecturer Molecular Biology), dr. C. Joo (lecturer Physics, Biophysics), dr. F. van de Bult (lecturer Analysis 1, 2, 3, chair Board of Studies), dr. B. Beaumont (lecturer Evolution, focus on course integration)
11.30 h. – 12.15 h.	Board of Examiners Dr. J. Pothof (chair Nanobiology sub-Board of Examiners), dr. ir. L. Laan (member Nanobiology sub-Board of Examiners), dr. K. Jaspers (former member Nanobiology sub-Board of Examiners), dr. S. Eijt (chair Applied Physics sub-Board of Examiners)
12.15 h. – 13.30 h.	Lunch panel (closed session), open office hours 12.15 h. – 12.45 h.
13.30 h. – 14.30 h.	Lecturers and theses' examiners Dr. M.E. Aubin-Tam (lecturer Labcourse 1, 2, Nanotechnology, Bachelor End Project supervisor), dr. T. Idema (lecturer Physics 1, Quantum Mechanics elective, Bachelor End Project supervisor), dr. H. Youk (lecturer Physics, Bachelor End Project supervisor), prof. dr. J. Gribnau (lecturer Evolutionary Development, Bachelor End Project supervisor), dr. ir. J. Marteijn (lecture Genetics, Bachelor End Project supervisor prof. dr. A. Houtsmuller (lecturer Biomolecular Dynamics, Biomolecular Dynamics, Nanoscopy practice, Bachelor End Project co-supervisor), dr. ir. W. Baarends (lecturer Evolutionary Development, member Board of Studies)
14.30 h. – 15.30 h.	Students and alumni, including Board of Studies members B. Nieuwenhuis (SNVB Hooke study association, education commissioner), M. Smit (member Faculty Student Council), E. Middendorp (member Board of Studies), W. Teunisse (member Board of Studies), G. Kockelkoren (president Faculty Student Council), E. Schonfeld BSc (student Master Artificial Intelligence, University of Amsterdam), E. Şahin BSc (student Master Nanobiology), E. Adegeest (student Master Nanobiology)
15.30 h. – 17.15 h.	Deliberations panel (closed session)
17.15 h. – 17.45 h.	Main findings presented by panel chair to programme management

Annex 2: Documents studied

The panel studied the following documents, presented prior to the site visit:

- Bachelor Nanobiology, Critical Reflection
- Subject-specific reference framework
- Modules chart
- Schematic curriculum overview
- Programme competences matrix
- Bachelor End Project assessment form
- Bachelor End Project grading scheme
- Quantitative data
- Overview of staff
- List of graduates
- Cooperation agreement Delft University of Technology and Erasmus University Rotterdam
- Teaching and Examination Regulations
- Long-term Strategic Plan, Faculty of Applied Sciences, Delft University of Technology
- Strategy, Erasmus Medical Center, Erasmus University Rotterdam
- Honours Programme description
- Programme Factsheet
- Implementation Regulation programme
- Justification Numerus fixus
- Previous accreditation report
- Assessment Policy
- Annual Report Board of Examiners
- Rules and Regulations Board of Examiners
- Bachelor End Project Step-by-Step Guide
- Report Mid-term Review

On the day of the site visit, programme management presented the following documents:

- Selection of course material
- Selection of examinations
- Minutes Board of Studies
- Reports Board of Examiners

Annex 3: Final products reviewed

The Bachelor End Projects (theses) of the following 15 students have been selected for review by the panel.

- 4222385
- 4231198
- 4289994
- 4259688
- 4270142
- 1546252
- 4295692
- 4206274
- 4299310
- 4326350
- 4282361
- 4289447
- 4305086
- 4257952
- 4159675

Annex 4: Composition of the assessment panel

The assessment panel had the following composition:

- Prof. dr. ir. E.J.G. Peterman, full professor Physics of Living Systems, Vrije Universiteit Amsterdam (panel chair);
- Prof. dr. ir. M.M.A.E. Claessens, full professor Nanobiophysics, University of Twente (panel member);
- Prof. dr. J.A.E. Eggermont, full professor Cell Physiology. KU Leuven (panel member);
- J.C. van Campenhout LLB, student pre-master programme Law, Tilburg University (student member).

Prof. dr. ir. E.J.G. Peterman (panel chair)
Mr. Peterman is full professor Physics of Living Systems at Vrije Universiteit Amsterdam. He took his doctorate from Vrije Universiteit Amsterdam. He was employed as a researcher at universities in the United States, among which Stanford University. In addition, he was a visiting professor at universities in France, the Philippines and the United States. Mr Peterman was a member of a number of scientific panels. He held and holds positions in education, such as director of the bachelor and master programmes Medical Natural Sciences.

Prof. dr. ir. M.M.A.E. Claessens (panel member)
Mrs. Claessens is full professor Nanobiophysics at University of Twente. She studied Molecular Sciences at Wageningen University and took her doctorate from Wageningen University. She was employed as a researcher at Technical University Munich and as assistant professor and associate professor at University of Twente. In addition, she held a number of national and international positions in her research field. Mrs. Claessens is a member of a number of committees regarding education within University of Twente.

Prof. dr. J.A.E. Eggermont, (panel member)
Mr. Eggermont is full professor Cell Physiology at KU Leuven. He took his doctorate in Medical Sciences from KU Leuven. He was a post-doctorate fellow at University of Oxford in the United Kingdom and collaborated with universities in South Africa, Turkey, China and the United States. He held a number of positions within KU Leuven, among which vice-dean of the Medical Faculty. Mr Eggermont is chair of the Board of Examiners for the admission examinations for medical doctors and dentists in Flanders.

J.C. van Campenhout LLB (student member)
Mr. Van Campenhout is a student in the pre-master programme in Law at University of Tilburg. Prior to his current study, he completed the Law programme at University of Applied Sciences Avans-Fontys Law School. For this latter programme, he was, among other, a student member and the student chair of the programme committee. Mr. van Campenhout participated in several panels for the accreditation of higher education programmes in the Netherlands.