Appendix: Programme Specifics for the MSc Programme Nanobiology

Part of the Course and Exam Regulation of the Master's Programme
As referred to in Paragraph 2 of the Teaching and Exam Regulations

Faculty of Medicine (Erasmus MC)
Erasmus University Rotterdam

and

Faculty of Applied Sciences
Delft University of Technology

2022-2023

Contents

Section 1 Appendix to the TER

TER Article 3 Admissions

The Master's degree programme in Nanobiology is a multidisciplinary programme with mathematics, physics and biology as core subjects. Due to the multidisciplinary content of the programme we require a solid background in university mathematics (calculus, linear algebra and differential equations), physics and molecular biology. How to complete the requirements for admission depend on the educational background of the applicant.

TER Article 3.1 A Dutch University BSc degree

The master's degree programme is accessible to students without further requirements after completion of their bachelor's degree in Nanobiology.

Students holding a Dutch University BSc degree from another programme can be admitted, but may be required to take additional courses to compensate for any gaps in prior education. More information can be found below under Bridging Programme (TER Article 3.4 and section 5 article 8).

TER Article 3.2 A Non-Dutch University Bachelor's

Applicants with degrees from non-Dutch universities seeking admission to the MSc programme in Nanobiology must in most cases possess a Bachelor of Science degree covering the required coursework. Their application will be evaluated by the Admission Committee, based upon academic scores and may include an interview. Perceived deficiencies will be identified in the review process and will need to be addressed by taking appropriate courses before the applicant can be admitted into the MSc programme. Applicants residing in the Netherlands may be eligible for a Bridging programme, more information can be found below under Bridging Programme (TER Article 3.4 and section 5 article 8)

TER Article 3.3 Dutch University of Applied Sciences (HBO)

A Bachelor's degree from a university of applied sciences does not qualify applicants for direct admission to the Master's degree programme in Nanobiology.

TER Article 3.4 Bridging Programmes Eligibility

Applicants who have a Bachelor's degree from a Dutch University or who are resident in the Netherlands, may be eligible to complete a bridging programme to remediate any gaps in prior education. The bridging programme for the MSc programme is always customised to the students' specific situation in consultation with the programme coordinator and Admission Committee. Students will have up to two years to complete their bridging programme. See Section 5 article 8 for more information about bridging programmes.

Given there is no nanobiology programme in universities of applied science (HBO), a bachelor's degree from a university of applied sciences does not qualify applicants for access to a Nanobiology bridging programme.

TER Article 5 Goal of the Programme

The Nanobiology Master's programme has the following specific learning goals for our students.

TER Article 5.2

5.2.a. Knowledge

1 The student has theoretical and practical knowledge of the physics of biological processes and the methods to observe them.

2 The student is able to build mathematical models of physical and biological systems, and can solve them numerically and/or analytically.

3 The student can apply their knowledge to quantify biological processes from experimental results.

4 The student understands ethical issues in research.

5.2.b Research skills

5 The student is able to identify a problem and translate this into a research question.

6 The student is able to conduct comprehensive literature investigations, related to the research question.

7 The student is able to translate a research question into a research proposal.

8 In collaboration with other research group members, the student is able to set up and conduct a research project, collect data, analyse data, and come to conclusions.

9 The student is able to perform ethically responsible research.

5.2.c Communication skills

10 The student is able to write research findings in the form of a draft manuscript, which in collaboration with a research supervisor may be developed into a scientific article, suitable for publication in an international, peer-reviewed journal.

11 The student can communicate his or her results in oral and written form to audiences of specialists and non-specialists.

12. The student understands ethical considerations in communicating science.

Section 2 Programme Composition

Article 1 Obligatory Courses

The Nanobiology programme is a two-year master's programme and comprises 120 EC.

Courses that form part of the student's bachelor programme cannot be part of the Master's programme.
Columns 1-11 in the tables below indicate the programme goals above in TER 5.2.a-c

Article 1.1 Obligatory Courses of the first year

Course	Code	EC	Assessment method	1	2	3	4	5	6	7	8	9	10	11	12
Analytical Mechanics	NB4011	3	Homework, Written	X	X										
Biology of Cancer	NB4040	4	Report, Written			X		X	X	X	X			X	
Engineering Genetic Information	NB4030	3	Written	X		X	X	X		X	X				
High-Resolution Imaging	NB4020	4	Homework, Written	X	X	X	X						X	X	
Modeling Dynamical Systems	NB4050	3	Report, Group Work, quizzes	X	X	X		X	X	X	X			X	
Physics of Biological Systems: Mathematical Modelling in Systems Biology*	AP3162	6	Homework, presentation, written	X	X	X			X				X		
Soft Matter*	NB4070	6	Homework, written	X	X	X	X	X	X				X	X	X
Stochastic Processes With Applications	NB4012	3	Homework, Written	X	X	X		X			X				
Seminars	NB5015	2	Reports										X	X	
Project Development Part 1	NB4510	3	Report, Presentation				X	X	X				X	X	
Project Development Part 2**	NB4520	7	Report, Presentation							X				X	X

*Students may take either NB4070 or AP3162 to meet this requirement. They may choose to take the other as an elective. If they take NB4070 and AP3162, then AP3162 counts as an elective.

**Students must have completed NB4510 Project Development Part 1 before NB4520 Project Development Part 2. Or receive permission of the teacher.

Article 1.2 Obligatory Courses of the second year

1.3.a Master End Project

Course	Code	EC	Assessment method	1	2	3	4	5	6	7	8	9	10	11	12
Master End Project Nanobiology	NB5942	42	Presentation, Oral	X	X	X	X	X	X	X	X	X	X	X	X

1.3.b Broadening Research Project

Students select one research project from the options listed. Only one will be included in their degree audit. Details about the procedures for these are in the Study Guide.

Course	Code	EC	Assessment method	1	2	3	4	5	6	7	8	9	10	11	12
Internship*	NB4060	18	Report					X	X		X	X	X	X	X
Academic Research Project*	NB4065	18	Report					X	X		X	X	X	X	X
iGem*	LM3961	18	Report, Presentation					X	X					X	X
Joint Interdisciplinary Project	TUD4040	15*	Presentation, Participation, Report		X	X								X	X
Physics Design Project	AP3841	15*	Presentation, Participation, Report		X	X								X	X

*TUD4040 Joint Interdisciplinary Project requires completion of an additional 3EC of elective courses. AP3841 Physics Design Project requires completion of AP3831 Systems Engineering for Physicists in Q4 of the previous year.

Article 1.3 Elective courses

In addition to the obligatory courses in the first and second year, students must earn at least 22 EC of elective courses.

Article 1.3.a contains a list of the electives currently offered by the Nanobiology MSc programme. Article 1.3.b. contains a list of electives from other programmes currently approved by the Board of Examiners for inclusion in the Nanobiology Master's programme. Students may request to include electives to their degree audit which are not on the approved list. Students must submit this request to the Board of Examiners before beginning the course(s).

Students may take one elective (no more than 6 EC) that is not related to Nanobiology content. It may be taken at any university but must be approved by the Board of Examiners to ensure appropriate level of study.

Article 1.3.a Nanobiology Programme Electives

Electives within the Nanobiology programme.

Course	Code	EC	Assessment method	1	2	3	4	5	6	7	8	9	10	11	12
Biological Networks: a data driven approach to discovery and understanding	NB4120	3	Written exam	X	X	X		X			X		X	X	
Engineering of Living Systems	NB4160	3	Written reports	X				X	X					X	
Geometry of Physics	NB4110	6	participation, presentation	X	X	X	X	X	X				X	X	X
Nuclear Architecture	NB4100	3	discussion, written exam	X				X	X					X	
The Origin and Synthesis of Life	NB4150	6	Homework, Presentation,			X		X	X	X					

Course	Code	EC	Assessment method	1	2	3	4	5	6	7	8	9	10	11	12
			Report, written exam												
Protein Quality Control Mechanisms	NB4080	3	Homework, written exam	X		X	X		X					X	
Stem Cells	NB4090	3	Presentation, written exam				X	X	X					X	X
Molecular Virology & Immunology	NB4165	3	written exam	X	X	X									
Independent Research*	NB5910	*	written												

*Starting an independent project must be discussed with the Nanobiology program and approved by the programme director prior to beginning the project. The program may begin a project and open registration to any students at any time.

Article 1.3.b Currently BoE approved electives from other programmes

The following electives from other programmes are approved for inclusion in the Nanobiology programme. They are created by other programmes and are not guaranteed to be taught in any given year. Students should check the Study Guide for availability and prerequisites when planning to include them.

Course code	Course name	EC
4373MUBI6	Multiscale Mathematical Biology (Leiden University)	6
4423CHEIM	Chemical Immunology (Leiden University)	6
AP3021	Advanced Statistical Mechanics	6
AP3032	Continuum Physics	6
AP3132	Advanced Digital Image Processing	6
AP3162	Physics of Biological Systems: Mathematical Modeling in Systems Biology[1]	6
AP3232	Medical Imaging Signals and Systems	6
AP3371	Radiological Health Physics	6
AP3582	Medical Physics Of Photon And Proton Therapy	6
AP3831	Systems Engineering for Physicists	3
BM41035	Biomaterials	4
BM41050	Applied Experimental Methods: Medical Instruments	4
BM41075	Regenerative Medicine	4
BM41090	Computational Mechanics Of Tissues And Cells	6
BM41155	3D Printing	4
CH3142	Molecular Thermodynamics (MTD)	6
CH3372A	Soft Matter For Chemical Products (SMP)	3
CH3681A	Reactors And Kinetics	6
CS4220	Machine Learning 1	5
CS4230	Machine Learning 2	5
CS4255	Algorithms for Sequence-Based Bioinformatics	5
CS4329	Recent Topics in Bioinformatics	5
EE4650	Advanced Magnetic Resonance Imaging	5
IFEEMCS4250	Statistical Learning for Engineers	4
IN4089	Data Visualization	5
LM3311	Green Chemistry And Sustainable Technology	3

[1] This course is a required course unless a student also takes NB4070 Soft Matter, in which case AP3162 Physics of Biological Systems: Mathematical Modeling in Systems Biology will count as an elective.

Course code	Course name	EC
LM3432	Analysis Of Metabolic Networks	6
LM3442	Metabolic Reprogramming	6
LM3451	Bioprocess Integration	5
LM3512NB	Systems Biology	6
LM3561	Ethical, Legal And Social Issues In Biotechnology	3
LM3581NB	Metabolic Systems Biology	3
LM3601	Molecular Biotechnology And Genomics	6
LM3611	Microbial Community Engineering	6
LM3701	Advanced Enzymology	6
LM3741	Fermentation Technology & Environmental Biotechnology	6
LM3751	Transport & Separation	6
LM3771	Protein Engineering	6
ME41095	Bio Inspired Design	4
ME45025	Introduction To Multiphase Flow	6
ME45043	Advanced Fluid Dynamics (Ap)for AP	5
ME46000	Nonlinear Mechanics	4
ME46072	Nonlinear Dynamics	4
SC42030	Control for High Resolution Imaging	3
TPM305A	Writing a Master's Thesis in English	2
WI4011-17	Computational Fluid Dynamics	6
WI4014TU	Numerical Analysis	6
WI4019	Non-Linear Differential Equations	6
WI4201	Scientific Computing	6
WI4204	Advanced Modeling	6
WI4205	Applied Finite Elements	6
WI4212	Advanced Numerical Methods	6
WI4430	Martingales, Brownian Motion, And Stochastic Processes	6
WM0201TU-Eng	Technical Writing	2
WM0320TU	Ethics and Engineering	3
WM-ITAV-4010	Scientific Writing	2
WM-ITAV-4020	Presenting for large audiences	2

Section 3 Examinations

Article 2 The form of examinations and methods of assessment

The form of the exams and the assessment strategy is described for each course in the studyguide: https://www.studiegids.tudelft.nl/

Examinors may specify different exam formats for the resits, these are also listed in the studyguide.

Attendance requirements are specified for each course in the studyguide or on Brightspace at the start of the course.

Rules on the composition of the final course grade can be found in the Master's programmes "Rules and Regulations of the Board of Examiners."

Article 3 Schedule of the exams

General timing for exams is included in each course's information in the study guide. Retake examinations are planned generally in the next exam week after the regular exam. Precise details of date and time is available in the TU Delft TimeTable.

Article 4 Master's End Project

Students may start their Master's End Project if they:

- have been admitted to the Nanobiology Master's programme,
- have completed bridging/homologation requirements and any obligations from their bachelor programme,
- have completed at least 35 EC of Nanobiology MSc courses,
- have completed NB4510 and NB4520 Project Development Part 1 and Part 2.
- have submitted and had approved the appropriate application form to the Thesis office.

Students are responsible for finding a supervisor for their project. Supervisors must be an approved Nanobiology programme supervisor, the list of approved supervisors is called the "Green List" and is available from the TNW Thesis Office Brightspace page. The Green List designates the research groups as specified in article 21a and b of the Rules and Guidelines of the Board of Examiners. If students do an Academic Research Project (NB4065) for their Broadening Research Project, they may not do it with the same supervisor as for their MEP.

The date and time of the Master's End Project presentation is determined by the end project supervisor, in consultation with the student. In exceptional cases, the programme director may be involved in setting the date and time.

Further rules governing the Master's End Projects can be found in the Rules and Guidelines of the Board of Examiners and on the TNW Thesis office BrightSpace page.

Article 4.1 Projects outside of Nanobiology Programme

Students must complete at least one of their research projects (MEP or Broadening) with a research group within the Nanobiology programme as designated by the GreenList. Academic Research Projects and Master End Projects outside of Nanobiology must be approved in advance by the Board of Examiners.

Article 4.1a Definition: External vs Internal Broadening Research Projects

For the purpose of Article 4.1, the following definitions apply:

NB4060 Internship is always considered an external project, and requires a GreenList internal supervisor as evaluator.

NB4065 Academic Research Project can be either internal or external depending on the research group the student does the project with, and always requires a GreenList supervisor as first or second evaluator.

LM3961 iGem is considered an internal project, it does not require a GreenList supervisor.

TUD4040 Joint Interdisciplinary Project is always an external project. It does not require a GreenList supervisor.

AP3841 Physics Design Project is always an external project. It does not require a GreenList supervisor.

Section 4 Special programmes

Article 5 Bridging programmes

At the time a student applies to join the Master's program, a decision is made whether they need to complete some additional coursework (homologation) to qualify to begin the programme. If their prior degree is from a Dutch university or they are a permanent resident of the Netherlands they may be able to complete these courses in a TU Delft Nanobiology bridging programme. The Nanobiology bridging programme is done in English and requires the same proof of English as the Nanobiology Master's programme. The set of courses in a bridging programme is determined

individually for each student. The bridging programme may not consist of more than 60EC and students may take no more than two years to complete it. Up to 9 EC of a bridging programme may be completed after students begin the Master's programme, this must be agreed to with the programme coordinator. All others must be completed before enrolling in the Master's programme. Successful completion of the bridging programme qualifies the student for admission into the Master's programme.

Article 5.1 Required bridging/homologation courses for TU Delft BSc Life Science and Technology

Course	Code	EC
Optics & Microscopy	NB2041	3
Nanotechnology	NB2081	2
Image Analysis	NB2121	3
Physics 2	NB2141	3
Computational Science	NB2181	3
Differential Equations	NB2191	3
Electronic Instrumentation	NB2214	6
Statistical Physics	NB2220	3
Signals and Systems	TN2545	6

Students may wish to include Physics 1b NB1143. Analysis 3 NB1210 and Linear Algebra NB1230, or they can do these as self study.

Article 5.2 Required bridging/homologation courses for TU Delft BSc Applied Physics

Course	Code	EC
Biochemistry	NB1012	3
Molecular Biology	NB1016	3
Genetics	NB1022	4
Physical Biology of the Cell 1	NB1072	3
Chemistry 1	NB1102	3
Chemistry 2	NB1110	3
Labcourse A1 or B1	NB1150 or NB1163	3
Evolutionary & Developmental Biology	NB2032	6
Microscopy/Nanoscopy Practice or Optics & Microscopy	NB2046 or NB2041	1.5/3
Physical Biology of the Cell 2	NB2071	3
Image Analysis	NB2121	3
Bioinformatics	NB2161	4.5
Biomolecular Structure & Function	NB2230	3

Students will be placed into either NB1150 or NB1163 as there is room.

Article 6 Honour's programme (HPM)

The Honour's Programme consists of at least 20 EC in addition to the Master's programme of 120 EC. It is an individualized programme that contains a 5 EC course for all TU Delft honours programme students plus a coherent package of at least 15 EC of challenging course modules or projects composed by the student.

Students receive an honour's certificate with their diploma if they have completed their MSc Programme and completed all HPM courses within two years of completing the first MSc exam. More details are available in the Study Guide.

Collective Part (5 EC)
UD2010, Critical Reflection on Technology, 5 EC, obligatory
Individual Part (15 EC) **Possibilities:** AS1011HPM, Applied Sciences Company Project, 12EC plus AS1021HPM Applied Sciences Honours Classes AS1031HPM, Applied Sciences Research Project, 9-15 EC plus 0-6 EC related coursework for a total of 15 EC Courses: Coherent collection of 15 EC of challenging courses. Design PDEng Project

Section 5 Additional Rules

Article 7 Transition rules

7.1 Per academic year 2016-2017

Elective courses are not divided in different categories. Student can choose any elective from the proposed list in article 3. In retrospect this also counts for the students from cohort 2015.

7.2 Per academic year 2019-2020:

- Soft Matter (NB4070) will be a mandatory course for all students starting the Nanobiology Master's programme in September 2019 and later.
- The Seminars course (NB5010) has become a 2 EC course (NB5015) for all students starting the Nanobiology Master's programme in September 2019 and later. Students from the 2019 cohort will need to complete this requirement for their programme and an additional 2 EC of electives (22 total). Students from 2018 or earlier, can receive 4 EC under the old course code of NB5010.

7.3 Per academic year 2020-2021:

- NB4010 has been divided into two courses NB4011 and NB4012. Completion of both of these will fulfil requirements for NB4010 for prior cohorts.
- Students beginning in 2020 and later may select between AP3162 and NB4070 to fulfil the Physics requirement. Students from the 2019 cohort may request this option from the Board of Examiners.

7.4 Per academic year 2021-2022:

- Change to the language of how many credits are required for starting MEPs. The new rule is a clarification and simplification of the calculation of the previous requirement. If exceptions are needed, they can be discussed with the programme coordinator.

7.5 Per academic year 2022-2023:

- Students doing a bridging programme which includes Evolution may substitute the new course NB2230 Biomolecular Structures and Function.
- Two paths to completing the 54 EC of MEP and surrounding courses. Students starting their MEP prior to Q3 2022-2023 will use the old path. Students starting their MEP in Q3 of 2022-2023 or later will need to do the new path. Students who have completed NB5020, NB5030, and NB5040 will use NB5900 for their MEP course code. NB5015 Seminars is the same in both paths.

Old		**New**	
Course	**EC**	**Course**	**EC**
NB5015 Seminars	2	NB5015 Seminars	2
NB5020 Literature Review NB5030 Project Proposal Writing NB5040 Research Presentation	4 2 2	NB4510 Project Development Part 1 NB4520 Project Development Part 2	3 7
NB5900 Master End Project Nanobiology	44	NB5942 Master End Project Nanobiology	42

- Students who wish to start their MEP in Q3 or Q4 of 2022-2023 will be allowed to begin their MEP before completing NB4510 and NB4520 with permission from the Academic Counsellor. They will need to complete NB4510 and NB4520 before they complete their MEP.
- Students from prior cohorts may also do an independent research project as an elective. Projects must be approved by the Programme director prior to beginning.

Article 8 Degree supplement

An overview of the study modules taken is given on the certificate. The degree supplement is issued in English.

Article 9 Date of commencement

These regulations will come into effect on 5 September 2022.