university of groningen

faculty of science and engineering

Appendices
to
Teaching and Examination regulations: Bachelor's degree programme in Mathematics

2019-2020

Appendix I Learning outcomes of the Bachelor's degree programme (Article 3.1.a)

As a consequence of the ongoing automation of society and the technological innovations that go along with this, the call of our society for mathematics is growing. Underneath virtually every form of automation lies a mathematical concept or model. In order to be able to respond to this development in society, it is important that mathematics is utilized in a proper and effective way. This requires that society has access to sufficiently many well qualified and highly trained mathematicians.

The Bachelor's degree programme in Mathematics aims to impart knowledge, skills, understanding and an academic attitude in the field of mathematics by means of a broadly based curriculum such that Bachelor's graduates are able to pursue an independent career as independent professionals and are also qualified for further training to become academic researchers in the field.

The Bachelor's graduate must be able to progress to the follow-on Master's degree programme in Mathematics. Graduates of the Bachelor's degree programme in Mathematics should also be able to take the Master's degree programme in Education and Communication. In addition, Bachelor's graduates who have taken the '*Educatieve Minor*' (teacher-training Minor) gain a Grade Two teaching qualification in mathematics.

Learning outcomes BSc Mathematics track General Mathematics

The above aim has been translated into a set of learning outcomes which consists of generic learning outcomes complemented with specified learning outcomes with respect to both Knowledge and Skills.

A. Generic learning outcomes – Knowledge

Bachelor's graduates in Mathematics track General Mathematics

A1. have general knowledge of the foundations and history of mathematics.

A2. have mastered the basic concepts of mathematics (see Appendix I for further specification) to a certain extent and are familiar with the interrelationships of these concepts within mathematics as well as with other disciplines (e.g. physics, logic, or philosophy).

A3. have in-depth knowledge of several current topics within mathematics.

A4. are familiar with the quantitative character of mathematics and have an understanding of the methods used in this field.

A5. have sufficient knowledge and understanding of mathematics to successfully complete a follow-up Master's degree programme in Mathematics.

A6. are aware of the societal, ethical and social aspects involved in the field of mathematics.

B. Generic learning outcomes – Skills

Bachelor's graduates in Mathematics track General Mathematics

B1 (Research) are able to draw up a research question, design, plan and conduct research and report on it independently with a certain degree of supervision. Bachelor's graduates are able to evaluate the value and limitations of their research and assess its applicability outside their own field. See Appendix II for further specification.

B2 (Problem Solving) are able to identify, apply, and choose among several potentially appropriate mathematical methods, persist in the face of difficulty, emphasize the importance of clarity and precision, and present solutions that include appropriate justification for their reasoning. See Appendix II for further specification.

B3 (Gathering information) are able to gather relevant information using modern means of communication and to critically interpret this information.

B4 (Collaborating) are able to collaborate intellectually and creatively in diverse contexts, while applying mathematical reasoning as well as emphasizing its importance.

B5 (Communicating) are able to communicate orally and in writing in academic and professional contexts, with both colleagues and others, in English. They are familiar with the relevant means of communication.

B6 (Reflecting) are able to assess their own actions and those of others in a natural sciences context, bearing in mind the social/societal and ethical aspects.

B7 (Learning skills) are able to apply learning skills that enable them to pursue a follow-up degree and acquire knowledge in new fields with a high level of autonomy.

Appendix I Specified basic knowledge related learning outcomes

Bachelor's graduates in Mathematics track General Mathematics

1.1. have mastered the basic concepts and techniques of mathematics, in particular single and multivariable calculus, linear algebra, analysis, ordinary differential equations, probability theory and statistics, and algebra.
1.2. have knowledge of more advanced subjects within the fields of algebra and geometry, analysis and numerical mathematics, dynamical systems and statistics.
1.3. have specific knowledge of one of the fields of Pure Mathematics.
1.4. have gained knowledge of and experience in the 'heart' of mathematics, i.e. understand the basic rules of logic, appreciate the role of mathematical proof, proficiently construct logical arguments and rigorous proofs, formulate and solve abstract mathematical problems.
1.5. recognize connections between different branches of mathematics, understand the connections between theory and applications, and have knowledge of various applications of mathematics.
1.6. are able to use mathematical software packages in an effective way or, if necessary, modify programs themselves.

Appendix II Degree programme-specific learning outcomes – Skills

Bachelor's graduates in Mathematics track General Mathematics

Research

2.1 have an academic attitude, which means they are curious, critical, creative and dare to show initiative.
2.2 are able to formulate relatively simple mathematical questions and problems in an exact way and if necessary adapt them to make them tractable

2.3 are able to articulate assumptions, understand the importance of detailed definitions, and are able to think in an organized way, to apply exact logical arguments when solving problems, and to generalize and abstract.
2.4 are able to analyze and abstract simple problems that are outside the scope of their own study programme and to independently acquire new knowledge to this end.

Problem solving

2.5 are able, under supervision and from the perspective of their field of interest, to translate a problem into a relevant mathematical problem definition and to this end formulate and evaluate a solution based on source research.
2.6 are able to distinguish a coherent argument from a fallacious one, make vague ideas precise by formulating them in the mathematical language, recognize real-world problems that are amenable to mathematical analysis, and use fundamental mathematical concepts and methods to study these problems.
2.7 are able to approach mathematical problems on the basis of a certain logical system and with determination to find the right method of approach.
2.8 are aware of the importance of researching specific cases and examples and have the attitude and skills necessary to critically evaluate the solutions found, test them for correctness and interpret them.
2.9 are able, by abstracting and reasoning, to delve into the root of a problem and determine whether existing methods can be applied or new methods must be developed.

Learning outcomes BSc Mathematics track Probability and Statistics

This track differs in the following learning outcomes from the track General Mathematics

A2’. have mastered the basic concepts of mathematics and statistics (see Appendix I’ for further specification) to a certain extent and are familiar with the interrelationships of these concepts within mathematics as well as with other disciplines (e.g. econometrics, life sciences, physics).

B2’ (Problem Solving, Statistical Modelling) are able to identify, apply, and choose among several potentially appropriate mathematical methods, present solutions that include appropriate justification for their reasoning, and are able to translate a problem, in particular a design problem, into a plan of approach and – taking into account the requirements of the client and/or technical preconditions – find a solution. See Appendix II’ for further specification.

B5’ (Communicating) are able to communicate orally and in writing in academic and professional contexts, in English, and are able to interact with mathematicians as well with scientists who apply statistical methods. They are familiar with the relevant means of communication.

Appendix I’ Specified basic knowledge related learning outcomes

Bachelor’s graduates in Mathematics track Probability and Statistics

1.1. have mastered the basic concepts and techniques of mathematics, in particular single and multivariable calculus, linear algebra, analysis, ordinary differential equations, probability theory and statistics, and algebra.
1.2. have knowledge of more advanced subjects within the fields of algebra and geometry, analysis and numerical mathematics, dynamical systems and statistics.
1.3. have specific knowledge of one of the fields of Pure Mathematics, and Statistics and Econometrics.
1.4. have gained knowledge of and experience in precise (both mathematical and statistical) reasoning and mathematical proof.

1.5. recognize connections between different branches of mathematics, recognize the connections between theory and applications, and have knowledge of basic sciences at a level necessary to apply statistical or mathematical methods, and are aware of the wider multidisciplinary context of (life) science and engineering.
1.6. are able to use mathematical software packages in an effective way or, if necessary, modify programs themselves.

Appendix II' Degree programme-specific learning outcomes – Skills

Bachelor's graduates in Mathematics track Probability and Statistics

Research

2.1 have an academic attitude, which means they are curious, critical, creative and dare to show initiative.
2.2 are able to formulate relatively simple mathematical questions and problems in an exact way and if necessary adapt them to make them tractable
2.3 are able to articulate assumptions, understand the importance of detailed definitions, and are able to think in an organized way, to apply exact logical arguments when solving problems, and to generalize and abstract.
2.4 are able to analyze and abstract simple problems that are outside the scope of their own study programme and to independently acquire new knowledge to this end.

Problem solving, Statistical Modelling

2.5 are able, under supervision and from the perspective of their field of interest, to translate a problem into a relevant mathematical problem definition and to this end formulate and evaluate a solution based on source research.
2.6 are able to make vague ideas precise by formulating them in the mathematical language, recognize real-world problems that are amenable to mathematical/statistical analysis, and are able to discuss the assumptions underlying their mathematical/statistical model, use mathematical/statistical concepts and methods to study these models.
2.7 are able to approach mathematical problems on the basis of a certain logical system and with determination to find the right method of approach and are aware of the limitations of the chosen method.
2.8 are aware of the importance of researching specific cases and examples and have the attitude and skills necessary to critically evaluate the solutions found, test them for correctness and interpret them.
2.9 are able, by modelling, abstracting and reasoning, to delve into the root of a problem and determine whether existing methods can be applied or new methods must be developed.
2.10 are able to conduct searches of literature, to critically use scientific databases and other sources of information, or to consult specialists to carry out statistical and mathematical analysis in order to study problems in (life) science and engineering.

Appendix II Majors and Minors of the degree programme (Article 3.7)

The Bachelor's degree programme in Mathematics has two tracks:
- General Mathematics
- Probability and Statistics

Each track comprises
1) a Major (150ECTS)
2) a Minor (30 ECTS) formed by 2 components:
   - a compulsory deepening minor Mathematics (15 ects, in minor slot period 1b, year 3)
   - a minor (15 ects, in minor slot period 1a, year 3) to be chosen from
     a. University-wide broadening Minors
     b. Faculty-wide deepening Minors
     c. Minor Mathematics for General Mathematics
     d. Minor Mathematics for Probability and Statistics
     e. Optional Minor, based on an individual choice of course units to be approved by the Board of Examiners.

Minor abroad (30 ects)
Students who want to study abroad, can do so in semester I of year 3. They do not have to take the courses of the compulsory minor Mathematics in minor slot period 1b, year 3, i.e. not

Track General Mathematics	Track Probability and Statistics
One out of four: - Analysis on Manifolds - Advanced Algebraic Structures - Philosophy of Science - Oriëntatie op Onderwijs in de Bètawetenschappen	Asymptotic Statistics
Elective track General Mathematics	Stochastic Models
Elective track General Mathematics	Elective track Probability and Statistics

The minor abroad needs to satisfy the following conditions:
- at least 15 ects of Mathematics (related) courses relevant for the student's track (at the discretion of the Board of Examiners)
- two packages of 15 ects or one package of 30 ects (i.e. 15 ects of Mathematics (related) courses relevant to the student's track and 15 ects in a different field or 30 ects of Mathematics (related) courses relevant to the student's track)
- each package of sufficient coherence and level (at the discretion of the Board of Examiners)

Education minor (30 ects)
Students who want to take the education minor are allowed to take a 30 ects minor in semester 1 of year 3 and do not have to take the courses of the compulsory minor Mathematics in minor slot period 1b, year 3 (see the table above).

Appendix III Course units in the propaedeutic phase

- **List of course units (Article 4.1.1)**
- **Practicals (Article 4.2.1)**

The propaedeutic phase of the Bachelor's degree programme in Mathematics with tracks in General Mathematics and Probability and Statistics comprises a compulsory joint programme and two electives.

3-1. Compulsory programme, year 1

Course unit name	ECTS	Entry requirements	Practical
Calculus 1	5	-	x
Kaleidoscope Mathematics	5	-	
Mechanics and Relativity 1	5	-	
Linear Algebra 1	5	-	x
Analysis	5	-	
Elective 1	5	See 3-2	
Calculus 2	5	-	
Computer-Aided Problem-Solving	5	-	x
Linear Algebra 2	5	-	
Linear Systems	5	-	
Probability Theory	5	-	
Elective 2	5	See 3-2	

3-2 Optional course units, year 1

Course unit name	ECTS	Entry requirements	Practical
Elective 1 , 1 out of:			
• OR Modelling	5	-	x
• Introduction to Logic	5	-	
• Mechanics and Relativity 2	5	-	
Elective 2, 1 out of:			
• First-year Project Mathematics	5	-	x
• First-year Project Applied Mathematics	5	-	x

3-3 Propaedeutic phase double bachelor's degree in Mathematics and Physics

If a student desires to obtain a Bachelor's degree in Mathematics and a Bachelor's degree in Physics at the same time, the student has to fulfill the requirements of the Mathematics track General Mathematics as well as the Physics degree programme track Particle Physics with some adaptations.

For the propaedeutic phase of the bachelor's degree in Mathematics the double degree students have to comply with the programme given above in 1-1 and 1-2 with the exception that as optional course units these students should take:

Course unit name	ECTS	Entry requirements	Practical
Elective 1			
• Mechanics and Relativity 2*	5*	-	x
Elective 2, 1 out of:			
• First-year Project Mathematics	5	-	x
• Physics Laboratory 2	5	-	x

*in practive, the double bachelor students take Mechanics and Relativity (10 ects) instead of Mechanics and Relativity 1 (5 ects) and Mechanics and Relativity 2 (5 ects)

See the Appendix TER of the bachelor's degree programme in Physics for the requirements for the propaedeutic phase of the bachelor's degree in Physics for double degree students.

Appendix IV Course units in the post-propaedeutic phase
- **List of course units (Article 7.1.1)**
- **Practicals (Article 7.2.1)**
- **Compulsory order of examinations (Article 9.2)**

4-1 Post-propaedeutic phase bachelor's degree in Mathematics
The post-propaedeutic programme (major plus deepening minor Mathematics (15 ects)) consists of common compulsory courses (60 ects), track specific compulsory courses (for General Mathematics 30 ects and for Statistics and Probability 40 ects), elective courses (for General Mathematics 15 ects and for Statistics and Probability 5 ects), and a minor Mathematics (15 ects)

Common compulsory courses (60 ects)

Course unit name	ECTS	Entry requirements	Practical
Group Theory	5	-	
Statistics	5	-	
Complex Analysis	5	-	
Partial Differential Equations	5	-	
Metric and Topological Spaces	5	-	
Numerical Mathematics	5	-	X
Mathematics: history, ethics and career	5	-	X
Functional Analysis	5	-	
Bachelor Workgroup Mathematics	5	-	X
Bachelor project Mathematics	15	Passed 150 ECTS of the Bachelor's programme in Mathematics	X

Track specific compulsory courses General Mathematics (30 ects)

Course unit name	ECTS	Entry requirements	Practical
Dynamical Systems	5	-	
Geometry	5	-	
One out of two: - Project Security and Coding - Project Chaos Theory	 5 5	 - -	 x x
Multivariable Analysis	5	-	
Algebraic Structures	5	-	
One out of four: - Analysis on Manifolds - Advanced Algebraic Structures - Philosophy of Science - Oriëntatie op Onderwijs in de Bètawetenschappen	 5 5 5 5	 - - - -	 x

Optional course units General Mathematics (15 ects)
The optional course units can be chosen from the post-propaedeutic track specific courses General Mathematics, the post-propaedeutic track specific courses Probability and Statistics, and the compulsory Applied Mathematics courses as long as they are not otherwise part of the student's programme.

In addition the optional course units can be chosen from the following list of courses:

Course unit name	ECTS	Entry requirements	Practical
At most one out of: - Imperative Programming - C++, part I	 5 5	 - -	 x x
C++, part II	5	-	x
Dynamic Econometrics	5	-	
Game Theory	5	-	
Risk Insurance	5	-	X
Symmetry in Physics	5	-	
Quantum Physics 1	5	-	
Discrete Mathematics	5	-	

Minor Mathematics for General Mathematics (15 ects)
Courses chosen from the optional course units General Mathematics as described above, if not already chosen for the major plus deepening Minor Mathematics.

Track specific compulsory courses Probability and Statistics (45 ects)

Course unit name	ECTS	Entry requirements	Practical
Discrete Mathematics	5	-	
Probability and Measure	5	-	
Stochastic Processes	5	-	
One out of two: - Introduction to Actuarial Sciences - Introduction to Econometrics	 5 5	 - -	 x x
Project Statistical Reasoning	5	-	x
Asymptotic Statistics	5	-	
Stochastic Models	5	-	x
Statistical Modelling	5	-	x

Optional course units for Probability and Statistics (5 ects)
The optional course units can be chosen from the post-propaedeutic track specific courses General Mathematics, the post-propaedeutic track specific courses Probability and Statistics, and the compulsory Applied Mathematics courses as long as they are not otherwise part of the student's programme.

In addition the optional course units can be chosen from the following list of courses:

Course unit name	ECTS	Entry requirements	Practical
At most one out of: - Imperative Programming - C++, part I	 5 5	 - -	 x x
Dynamic Econometrics	5	-	x
Game Theory	5	-	
Risk Insurance	5	-	x
Statistical Signal Processing	5	-	

Minor Mathematics for Statistics and Probability (15 ects)
courses chosen from the optional course units Statistics and Probability as described above, if not already chosen for the major plus deepening Minor Mathematics.

4-2 Post-propaedeutic phase double bachelor's degree in Mathematics and Physics

If a student desires to obtain a Bachelor's degree in Mathematics and a Bachelor's degree in Physics at the same time, the student has to fulfill the requirements of the Mathematics track General Mathematics as well as the Physics degree programme track Particle Physics with some adaptations.

For the post-propaedeutic phase of the bachelor's degree in Mathematics the double degree students have to comply with the programme of the track General Mathematics given above in 4-1 with the following adaptations:

Common compulsory courses

Course unit name	ECTS	Entry requirements	Practical
Choice, 1 out of • Mathematics: history, ethics and career • Physics, Astronomy, Ethics, and Society	 5 5	 - -	 x x
Bachelor Project Mathematics and Physics*	20	Passed 150 ECTS of the Bachelor's programme in Mathematics as well as Physics	x

*instead of Bachelor Project Mathematics of 15 ects

Optional course units (15 ects)

Course unit name	ECTS	Entry requirements	Practical
Optional course units (15 ects)			
• Quantum Physics 1 (compulsory)	5	-	
• Symmetry in Physics (compulsory)	5	-	
• 1 post-propaedeutic course unit of your choice from the BSc Physics	5		

Minor
3 post-propaedeutic course units of your choice from the BSc Physics.

See the Appendix TER of the bachelor's degree programme in Physics for the requirements for the post-propaedeutic phase of the bachelor's degree in Physics for double degree student.

Appendix V Entry requirements (Articles 2.2.1, 2.2.2, 2.2.3)

A. Deficient VWO-diploma

1. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

Bacheloropleiding *Bachelor's degree programme*	**N+T**	**N+G**	**E+M**	**C+M**
Biologie *Biology*	Biologie	Natuurkunde	Wiskunde A of B Natuurkunde Scheikunde Biologie	Wiskunde A of B Natuurkunde Scheikunde Biologie
Farmacie *Pharmacy*	V	Natuurkunde	Natuurkunde Scheikunde	Wiskunde A of B Natuurkunde Scheikunde
Life Science and Technology **Scheikunde** *Chemistry* **Scheikundige Technologie** *Chemical Engineering*	V	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde Scheikunde	Wiskunde B Natuurkunde Scheikunde
Informatica *Computing Science* **Technische Bedrijfskunde** *Industrial Engineering and Management* **(Technische) Wiskunde** *(Applied) Mathematics*	V	Wiskunde B	Wiskunde B	Wiskunde B
Kunstmatige Intelligentie *Artificial Intelligence*	V	V	V	Wiskunde A of B
(Technische) Natuurkunde *(Applied) Physics* **Sterrenkunde** *Astronomy*	V	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde

2. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

B. HBO (university of applied science) propaedeutic certificate, other universities

1. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

Bachelor's degree programme	**Subjects at VWO (pre-university) level**	Requirement: Dutch as a Second Language (programme II) for non-native speakers of Dutch
B Biology	wia or wib + na+sk+bio	Yes
B Pharmacy	wia or wib + na+sk	Yes
B Life Science and Technology	wib+na+sk	Yes
B Computing Science	wib	
B Artificial Intelligence	wia or wib	
B Physics	wib+na	
B Chemistry	wib+na+sk	
B Astronomy	wib+na	
B Mathematics	wib	
B Chemical Engineering	wib+na+sk	
B Industrial Engineering and Management Science	wib	
B Applied Physics	wib+na	
B Applied Mathematics	wib	

wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

2. In addition, candidates are required to be competent in English:

Score -> Test	**Overall**	**Reading**	**Listening**	**Speaking**	**Writing**
IELTS (Academic)	6.5	6.5	6.5	6.5	6.5
TOEFL IBT (internet-based)	90	21	21	21	24
Cambridge English	CAE or CPE Certificate with a minimum score of 180				
English language test – TC UG	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

3. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

C. Foreign qualifications (EEA)

1. Any certificate that grants access to a university in a European country will also grant access to Dutch universities.

2. In the entrance examination, as referred to in art. 7.28, paragraph 3 of the Act, per country and educational institution specific training conditions are mentioned. These are standardized. The entrance examination is, in accordance with the Admissions Board Bachelor's programmes FSE, carried out by the Admissions Office. If for a specific diploma no standardisation has taken place then the requirements as formulated for candidates with a HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).

3. In addition, candidates are required to be competent in English:

Score -> Test	**Overall**	**Reading**	**Listening**	**Speaking**	**Writing**
IELTS (Academic)	6.5	6.5	6.5	6.5	6.5
TOEFL IBT (internet-based)	90	21	21	21	24
Cambridge English	CAE or CPE Certificate with a minimum score of 180				
English language test – TC UG	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

4. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

D. Foreign qualifications (non-EEA)

1. A non-European certificate that according to NUFFIC and/or NARIC standards is equivalent to a Dutch VWO certificate will grant access to university in the Netherlands.

2. In the entrance examination, as referred to in art. 7.28, paragraph 3 of the Act, per country and educational institution specific training conditions are mentioned. These are standardized. The entrance examination is, in accordance with the Admissions Board Bachelor's programmes FSE, carried out by the Admissions Office. If for a specific diploma no standardisation has taken place then the requirements as formulated for candidates with a HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).

3. In addition, candidates are required to be competent in English:

Score -> Test	Overall	Reading	Listening	Speaking	Writing
IELTS (Academic)	6.5	6.5	6.5	6.5	6.5
TOEFL IBT (internet-based)	90	21	21	21	24
Cambridge English	CAE or CPE Certificate with a minimum score of 180				
English language test – TC UG	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

4. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

E. Entrance examination (Colloquium Doctum)

1. The following requirements apply to the entrance examination as defined in Article 7.29 of the Act:

Degree programme	Nature and Health VWO level	or	Nature and Technology VWO level
B Biology	en, wia or b, sk, bio, na		en, wib, na, sk, bio
B Pharmacy	en, wia or b, sk, bio, na		en, wib, na, sk
B Life Science and Technology	en, wib, sk, bio, na		en, wib, na, sk
B Computing Science	en, wib, sk, bio		en, wib, na, sk
B Artificial Intelligence	en, wia or b, sk, bio		en, wib, na, sk
B Physics	en, wib, sk, bio, na		en, wib, na, sk
B Chemistry	en, wib, sk, bio, na		en, wib, na, sk
B Astronomy	en, wib, sk, bio, na		en, wib, na, sk
B Mathematics	en, wib, sk, bio		en, wib, na, sk
B Chemical Engineering	en, wib, sk, bio, na		en, wib, na, sk
B Industrial Engineering and Management Science	en, wib, sk, bio		en, wib, na, sk
B Applied Physics	en, wib, sk, bio, na		en, wib, na, sk
B Applied Mathematics	en, wib, sk, bio		en, wib, na, sk

en = English; wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

2. In addition, candidates are required to be competent in English:

Score -> Test	**Overall**	**Reading**	**Listening**	**Speaking**	**Writing**
IELTS (Academic)	6.5	6.5	6.5	6.5	6.5
TOEFL IBT (internet-based)	90	21	21	21	24
Cambridge English	CAE or CPE Certificate with a minimum score of 180				
English language test – TC UG	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

3. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

Appendix VI Clustering of Bachelor's degree programmes (Article 5.3.4, Article 5.6.1)

Degree programme CROHO code	Name of degree programme	Clustered with CROHO code	Name of degree programme
56286	B Life Science and Technology	56860 56157	B Biology B Pharmacy
56860	B Biology	56286 56157	B Life Science and Technology B Pharmacy
56157	B Pharmacy	56860 56286	B Biology B Life Science and Technology
56980	B Mathematics	56965 50206 56962 50205	B Applied Mathematics B Physics B Applied Physics B Astronomy
56965	B Applied Mathematics	56980 50206 56962 50205	B Mathematics B Physics B Applied Physics B Astronomy
50206	B Physics	56962 50205 56965 56980	B Applied Physics B Astronomy B Applied Mathematics B Mathematics
56962	B Applied Physics	50206 50205 56965 56980	B Physics B Astronomy B Applied Mathematics B Mathematics
50205	B Astronomy	56962 56965 50206 56980	B Applied Physics B Applied Mathematics B Physics B Mathematics
56857	B Chemistry	56960	B Chemical Engineering
56960	B Chemical Engineering	56857	B Chemistry

Appendix VII Admission to the post-propaedeutic phase (Article 6.1)

The following candidates will be admitted to the post-propaedeutic phase:

a. Students who have been issued a positive study advice from the bachelor's degree programme in Mathematics
b. Students who have been issued a positive study advice from the bachelor's degree programme in Applied Mathematics

Appendix VIII Contact hours propaedeutic phase (Article 3.6)

Bachelor year 1	
Type of contact	**Number of contact hours per year**
Lectures	335
Tutorials	290
Practical	25
Computer practical	40
Study support/Mentor groups	8
Internship support and guidance	-
Examinations	80
Misc. contact hours (symposia)	10

Appendix IX University Minors of the faculty of Science and Engineering (Article 8.5.1)

1. Neurosciences Minor (taught in English):
   - Neuroscience (15 ECTS)
   - Behavioural Neuroscience (15 ECTS)

   Future Planet Innovation (taught in English): (not offered in the academic year 2019-2020)
   - *Global Challenges (10 ECTS)*
   - *Sustainability in perspective (5 ECTS)*
   - *Sustainable contributions to society (15 ECTS)*

   Astronomy through Space and Time Minor (taught in English):
   - The Evolving Universe (5 ECTS)
   - Cosmic Origins (5 ECTS)
   - Astrobiology (5 ECTS)

   Einstein's physics: Space-time and parallel worlds (taught in English):
   - Einstein’s Universe (5 ECTS)
   - Quantum World (5 ECTS)
   - Building blocks of matter (5 ECTS)

2. The Programme Committee for the Bachelor’s degree programmes in Biology and Life Science and Technology also has authority in the field of the Minor “Neurosciences” and/or its course units.

   The Programme Committee for the Master’s degree programme in Energy and Environmental Sciences also has authority in the field of the Minor “Future Planet Innovation” and/or its course units.

   The Programme Committee for the Bachelor’s degree programme in Astronomy also has authority in the field of the Minor “Astronomy through Space and Time” and/or its course units.

   The Programme Committee for the Bachelor’s degree programmes in Physics and Applied Physics also has authority in the field of the Minor “Einstein's physics: Space-time and parallel worlds” and/or its course units.

3. The Board of Examiners for the Bachelor’s degree programmes in Biology and Life Science and Technology and the Master’s degree programmes in Biology, Ecology and Evolution, Marine Biology and Molecular Biology and Biotechnology also has authority in the field of the Neurosciences Minor and/or its course units.

The Board of Examiners for the Master's degree programme in Energy and Environmental Sciences also has authority in the field of the "Future Planet Innovation" Minor and/or its course units.

The Board of Examiners for the Bachelor's degree programme in Astronomy also has authority in the field of the Astronomy through Space and Time Minor and/or its course units.

The Board of Examiners for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Physics Minor "Einstein's physics: Space-time and parallel worlds" and/or its course units.

4. These Teaching and Examination Regulations also apply in their entirety to the Minors in Neurosciences, Future Planet Innovation, Astronomy through Space and Time and Einstein's physics: Space-time and parallel worlds and/or their course units.

Appendix X Transitional arrangement (Article 12.1)

For cohort 2017-2018 and earlier

Course	May be replaced with
Ordinary Differential Equations	Linear Systems
Metric Spaces	Metric and Topological Spaces
History of Mathematics	Mathematics: history, ethics and career
Project Mathematical Physics	Project Modelling
Measure and Integration	Probability and Measure
Security and Coding	Project Security and Coding
Chaos Theory	Project Chaos Theory
Statistical Reasoning	Project Statistical Reasoning
Project Dynamic Systems	Dynamic Systems

For cohort 2018-2019 and earlier

Linear Models in Statistics (EBB072A05)	Discrete Mathematics OR Linear Models in Statistics (EBB072A05)

See also the transitional arrangements in the appendices TER of previous years.