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

2021-2022



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 analyse 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 analyse 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 3.6)

The bachelor's degree programme in Mathematics has two tracks:

- General Mathematics
- Probability and Statistics

Each track comprises

- 1) a major (165 ECTS)
- 2) a minor (15 ECTS), 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. Personal 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 following courses:

Track General Mathematics	Track Probability and Statistics
One out of four: - Analysis on Manifolds (WBMA013-05) - Advanced Algebraic Structures (WBMA011-05) - Philosophy of Science (FI180WET) - Introduction to Science Education (Dutch) (WBEC002-05)	Asymptotic Statistics (WBMA002-05)
Elective track General Mathematics	Stochastic Models (EBB878A05)
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 following courses:

Track General Mathematics	Track Probability and Statistics
One out of four: - Analysis on Manifolds (WBMA013-05) - Advanced Algebraic Structures (WBMA011-05) - Philosophy of Science (FI180WET) - Introduction to Science Education (Dutch) (WBEC002-05)	Asymptotic Statistics (WBMA002-05)
Elective track General Mathematics	Stochastic Models (EBB878A05)
Elective track General Mathematics	Elective track Probability and Statistics



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	Course code	EC TS	Entry requirements
Calculus 1	WBMA003-05	5	-
Kaleidoscope Mathematics	WBMA006-05	5	-
Mechanics and Relativity 1	WBPH009-05	5	-
Linear Algebra 1	WBMA020-05	5	-
Analysis	WBMA012-05	5	-
Elective 1 (see 3-2)		5	-
Calculus 2	WBMA029-05	5	-
Computer-Aided Problem-Solving	WBMA030-05	5	-
Linear Algebra 2	WBMA035-05	5	-
Linear Systems	WBMA043-05	5	-
Probability Theory	WBMA046-05	5	-
Elective 2 (see 3-2)		5	-

3-2 Optional course units, year 1

Course unit name	Course code	EC TS	Entry requirements
Elective 1, one out of:	EBP821B05	5	-
- OR Modelling		5	-
- Introduction to Logic	WBAI013-05	5	-
- Mechanics and Relativity 2	WBPH021-05	5	-
Elective 2, one out of:			
- First-year Project Mathematics	WBMA041-05	5	-
- First-year Project Applied Mathematics	WBMA040-05	5	-



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 track Particle Physics with some adaptations.

Common compulsory courses

Course unit name	Course code	EC TS	Entry requirements
Calculus 1	WBMA003-05	5	-
Mechanics and Relativity	WBPH001-10	10	-
Linear Algebra 1	WBMA020-05	5	-
Calculus 2	WBMA029-05	5	-
Computer-Aided Problem-Solving <i>Or</i> Python for Physicists	WBMA030-05 WBPH044-05	5	-
First-year Project Mathematics <i>Or</i> Physics Laboratory 2	WBMA041-05 WBPH050-05	5 5	-

Programme Mathematics

Course unit name	Course code	EC TS	Entry requirements
Kaleidoscope Mathematics	WBMA006-05	5	-
Analysis	WBMA012-05	5	-
Linear Algebra 2	WBMA035-05	5	-
Linear Systems	WBMA043-05	5	-
Probability Theory	WBMA046-05	5	-

Programme Physics

Course unit name	Course code	EC TS	Entry requirements
Physics Laboratory 1	WBPH013-05	5	-
Physics of the Quantum Universe	WBPH028-05	5	-
Electricity and Magnetism	WBPH033-10	10	-
Mathematical Physics	WBPH049-05	5	-



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 9.3)

4-1 Post-propaedeutic phase bachelor's degree in Mathematics

The post-propaedeutic programme 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 (15 ECTS).

Common compulsory courses (60 ECTS)

Course unit name	Course code	EC TS	Entry requirements
Group Theory	WBMA005-05	5	-
Metric and Topological Spaces	WBMA036-05	5	-
Statistics	WBMA009-05	5	-
Complex Analysis	WBMA018-05	5	-
Functional Analysis	WBMA033-05	5	-
Numerical Mathematics 1	WBMA045-05	5	-
Partial Differential Equations	WBMA008-05	5	-
Bachelor Workgroup Mathematics	WBMA050-05	5	-
Mathematics & Society: Ethical and Professional Aspects	WBMA049-05	5	-
Bachelor's Project Mathematics	WBMA902-15	15	Passed 150 ECTS of the Bachelor's programme in Mathematics

Track specific compulsory courses General Mathematics (30 ECTS)

Course unit name	Course code	EC TS	Entry requirements
Multivariable Analysis	WBMA022-05	5	-
One out of two:			
- Project Security and Coding	WBMA026-05	5	-
- Project Chaos Theory	WBMA025-05	5	-
Dynamical Systems	WBMA031-05	5	-
Geometry	WBMA034-05	5	-
Algebraic Structures	WBMA039-05	5	-
One out of four:			
- Analysis on Manifolds	WBMA013-05	5	-
- Advanced Algebraic Structures	WBMA011-05	5	-
- Philosophy of Science	FI180WET	5	-
- Introduction to Science and Education (Dutch)	WBEC002-05	5	-



Track specific compulsory courses Probability and Statistics (40 ECTS)

Course unit name	Course code	EC TS	Entry requirements
Discrete Mathematics	WBMA019-05	5	-
Probability and Measure	WBMA024-05	5	-
Stochastic Processes	WBMA048-05	5	-
One out of two:			
- Introduction to Actuarial Sciences	EBB827A05	5	-
- Introduction to Econometrics	EBB828A05	5	-
Project Statistical Reasoning	WBMA038-05	5	-
Asymptotic Statistics	WBMA002-05	5	-
Stochastic Models	EBB878A05	5	-
Statistical Modelling	WBMA028-05	5	-

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.

Course unit name	Course code	EC TS	Entry requirements
Project Systems Theory	WBMA027-05	5	-
Fluid Dynamics	WBMA032-05	5	-
Project Modelling	WBMA047-05	5	-
Mathematical Modelling	WBMA007-05	5	-
Computational Methods of Science	WBMA004-05	5	-
Advanced Systems Theory	WBMA001-05	5	-
Calculus of Variations and Optimal Control	WBMA016-05	5	-
Numerical Mathematics 2	WBMA023-05	5	-
Discrete Mathematics	WBMA019-05	5	-
Probability and Measure	WBMA024-05	5	-
Stochastic Processes	WBMA048-05	5	-
Max. one out of :		5	-
- Introduction to Actuarial Sciences	EBB827A05		
- Introduction to Econometrics	EBB828A05		
Project Statistical Reasoning	WBMA038-05	5	-
Asymptotic Statistics	WBMA002-05	5	-
Stochastic Models	EBB878A05	5	-
Statistical Modelling	WBMA028-05	5	-
Project Security and Coding	WBMA026-05	5	-
Project Chaos Theory	WBMA025-05	5	-
Analysis on Manifolds	WBMA013-05	5	-



Advanced Algebraic Structures	WBMA011-05	5	-
Philosophy of Science	FI180WET	5	-
Introduction to Science and Education (Dutch)	WBEC002-05	5	-

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

Course unit name	Course code	EC TS	Entry requirements
At most one out of:			
- Imperative Programming	- BCS003-05	5	-
- C++ fundamentals	- WBCS033-05	5	-
Programming in C++	WBCS034-05	5	-
Dynamic Econometrics	EBB813A05	5	-
Game Theory	EBB872A05	5	-
Risk Insurance	EBB863A05	5	-
Symmetry in Physics	WBPH047-05	5	-
Quantum Physics 1	WBPH014-05	5	-

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.

Course unit name	Course code	EC TS	Entry requirements
Multivariable Analysis	WBMA022-05	5	-
Project Security and Coding	WBMA026-05	5	-
Project Chaos Theory	WBMA025-05	5	-
Dynamical Systems	WBMA031-05	5	-
Geometry	WBMA034-05	5	-
Algebraic Structures	WBMA039-05	5	-
Analysis on Manifolds	WBMA013-05	5	-
Advanced Algebraic Structures	WBMA011-05	5	-
Philosophy of Science	FI180WET	5	-
Introduction to Science and Education (Dutch)	WBEC002-05	5	-
Project Systems Theory	WBMA027-05	5	-
Fluid Dynamics	WBMA032-05	5	-
Project Modelling	WBMA047-05	5	-
Advanced Systems Theory	WBMA001-05	5	-
Mathematical Modelling	WBMA007-05	5	-
Numerical Mathematics 2	WBMA023-05	5	-
Calculus of Variations and Optimal Control	WBMA016-05	5	-
Computational Methods of Science	WBMA004-05	5	-



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

Course unit name	Course code	EC TS	Entry requirements
At most one out of:			
- Imperative Programming	- WBCS003-05	5	-
- C++ fundamentals	- WBCS033-05	5	-
Dynamic Econometrics	EBB813A05	5	-
Game Theory	EBB872A05	5	-
Risk Insurance	EBB863A05	5	-
Statistical Signal Processing	WBAS009-05	5	-

Minor Mathematics for General Mathematics (15 ECTS)

If you choose to follow a minor in General Mathematics, you can choose three of the courses from the optional course units General Mathematics as described above, if not already chosen for the major.

Minor Mathematics for Statistics and Probability (15 ECTS)

If you choose to follow a minor in Statistics and Probability, you can choose three of the courses from the optional course units Statistics and Probability as described above, if not already chosen for the major.

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 track Particle Physics with some adaptations.

Common compulsory courses

Course unit name	Course code	EC TS	Entry requirements
Complex Analysis	WBMA018-05	5	-
Mathematics & Society: Ethical and Professional Aspects	WBMA049-05	5	-
Or			
Physics, Astronomy & Society: Ethical and Professional Aspects	WBPH053-05	5	-
Symmetry in Physics	WBPH047-05	5	-
Bachelor Research Project (double BSc Physics+Maths)	WBPH901-20	20	Passed 150 ECTS of the Bachelor's programme in Mathematics as well as Physics



Programme Mathematics

Course unit name	Course code	EC TS	Entry requirements
Group Theory	WBMA005-05	5	-
Statistics	WBMA009-05	5	-
Partial Differential Equations	WBMA008-05	5	-
Metric and Topological Spaces	WBMA036-05	5	-
Numerical Mathematics 1	WBMA045-05	5	-
Functional Analysis	WBMA033-05	5	-
Bachelor Workgroup Mathematics	WBMA050-05	5	-
Dynamical Systems	WBMA031-05	5	-
Geometry	WBMA034-05	5	-
One out of two: - Project Security and Coding - Project Chaos Theory	-WBMA026-05 -WBMA025-05	5 5	- -
Multivariable Analysis	WBMA022-05	5	-
Algebraic Structures	WBMA039-05	5	-
One out of four: - Analysis on Manifolds - Advanced Algebraic Structures - Philosophy of Science - Introduction to Science and Education (Dutch)	- WBMA013-05 - WBMA011-05 - FI180WET - WBEC002-05	5 5 5 5	- - - -
Elective Mathematics		5	-

Programme Physics

Course unit name	Course code	EC TS	Entry requirements
Thermal Physics I + II	WBPH002-10	10	-
Quantum Physics 1	WBPH014-05	5	-
Waves and Optics	WBPH032-05	5	-
Structure of Matter I + II	WBPH034-10	10	-
Electronics and Signal Processing	WBPH038-05	5	-
Physics Laboratory 3	WBPH051-05	5	-
Quantum Physics 2	WBPH052-05	5	-
One out of two: - Atoms & Molecules - Subatomic Physics	WBPH003-05 WBPH031-05	5 5	-
One out of two: - Cosmology - Astroparticle Physics	WBAS001-05 WBPH036-05	5 5	-
One out of two: - Experimental Particle Physics - Relativistic Quantum Mechanics	WBPH040-05 WBPH045-05	5 5	-
One out of two: - Advanced Mechanics - Physics Laboratory 4	WBPH017-05 WBPH026-05	5 5	-



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Computational Methods in Science and Technology	WBPH005-05	5	-
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Minor

Three post-propaedeutic course units of your choice from the BSc Physics for the Mathematics programme and from the BSc Mathematics for the Physics programme.



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

A. Deficient VWO-diploma

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

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

- 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

- 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

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

IELTS (Academic)	6.5 - no less than 6.0 on each section
TOEFL IBT (internet-based test)	92 - no less than 21 on each section
TOEFL CBT (computer-based test)	237 - no less than 21 on each section
TOEFL PBT (paper-based test)	580 - no less than 55 on each section
Cambridge English	CAE or CPE Certificate
English language test - University of Groningen Language Centre	Minimum section scores C2 or C1 (one B2 allowed)

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

C. Foreign qualifications (EEA)

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

IELTS (Academic)	6.5 - no less than 6.0 on each section
TOEFL IBT (internet-based test)	92 - no less than 21 on each section
TOEFL CBT (computer-based test)	237 - no less than 21 on each section
TOEFL PBT (paper-based test)	580 - no less than 55 on each section
Cambridge English	CAE or CPE Certificate
English language test - University of Groningen Language Centre	Minimum section scores C2 or C1 (one B2 allowed)

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:

IELTS (Academic)	6.5 - no less than 6.0 on each section
TOEFL IBT (internet-based test)	92 - no less than 21 on each section
TOEFL CBT (computer-based test)	237 - no less than 21 on each section
TOEFL PBT (paper-based test)	580 - no less than 55 on each section
Cambridge English	CAE or CPE Certificate
English language test - University of Groningen Language Centre	Minimum section scores C2 or C1 (one B2 allowed)

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:

IELTS (Academic)	6.5 - no less than 6.0 on each section
TOEFL IBT (internet-based test)	92 - no less than 21 on each section
TOEFL CBT (computer-based test)	237 - no less than 21 on each section
TOEFL PBT (paper-based test)	580 - no less than 55 on each section
Cambridge English	CAE or CPE Certificate
English language test - University of Groningen Language Centre	Minimum section scores C2 or C1 (one B2 allowed)

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 and post-propaedeutic phase (Article 3.5)

Bachelor propaedeutic phase	
Type of contact	Number of contact hours per year
Lectures	335
Tutorials	290
Practical	25
Computer practical	40
Study support/Mentor groups	70
Internship support and guidance	-
Examinations	80
Misc. contact hours (symposia)	20

Bachelor post-propaedeutic phase	
Type of contact	Number of contact hours per year
Lectures	620
Tutorials	450
Practical	40
Computer practical	48
Study support/Mentor groups	-
Internship support and guidance	-
Examinations	240
Misc. contact hours (symposia)	30



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):

- 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 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 arrangements (Article 12.1)

Students following the Statistics and Econometrics track

2020/2021 was the last academic year students were able to graduate in the track Statistics and Econometrics. After August 31 2021, students who are following this track will have to switch to the new track Probability and Statistics and therefore comply with the courses offered in the track Probability and Statistics.

The following courses will become compulsory:

- Discrete Mathematics (WBMA019-05)
- Stochastic Processes (WBMA048-05)
- Project Statistical Reasoning (WBMA038-05) or Statistical Reasoning (WISR-11)

Highly encouraged if there is room in the programme of the student:

- Bachelor workgroup (WBMA050-05)
- Partial Differential Equations (WBMA008-05)

If the student is close to finishing their programme:

Course	May be replaced with
Bachelor Workgroup (WBMA050-05)	Project Systems Theory (WBMA027-05/WIIPST-07) <i>or</i> Project Dynamical Systems (WIIPDS-07) / Dynamical Systems (WBMA031-05) <i>or</i> Geometry (WBMA034-05 /WBMA17001) <i>or</i> Calculus of Variations and Optimal Control (WBMA016-05/WIVOB-09)
Partial Differential Equations (WBMA008-05)	Project Systems Theory (WBMA027-05/WIIPST-07) <i>or</i> Project Dynamical Systems (WIIPDS-07) / Dynamical Systems (WBMA031-05) <i>or</i> Geometry (WBMA034-05 /WBMA17001) <i>or</i> Calculus of Variations and Optimal Control (WBMA016-05/WIVOB-09)

These 4 replacement courses are no longer compulsory in the new programme.



For cohort 2019-2020 and earlier

Course	May be replaced with
C++, part I	C++ fundamentals
C++, part II	Programming in C++
Mathematics: history, ethics and career	Mathematics & Society: Ethics and Professional Aspects

For cohort 2018-2019 and earlier

Linear Models in Statistics (EBBo72A05)	Discrete Mathematics OR Linear Models in Statistics (EBBo72A05)
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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 <i>or</i> Mathematics & Society: Ethics and Professional Aspects
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

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