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Appendices for the Bachelor's degree programme(s) in Mathematics

2026-2027

Appendix I Learning outcomes of the Bachelor's degree programme (Article 3.1.1)

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 utilised 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 Applied Mathematics or 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

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

A. Generic learning outcomes – Knowledge

Bachelor's graduates in Mathematics:

A1. have general knowledge of the foundations and principal branches 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:

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, emphasise 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 emphasising 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:

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, statistics and algebra.
1.2. have knowledge of more advanced subjects within the fields of algebra, geometry, analysis, numerical mathematics, dynamical systems, probability 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:

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 organised way, to apply exact logical arguments when solving problems, and to generalise 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.

Appendix II Majors and Minors of the degree programme (Article 3.7.4 and 7.1.3)

The degree programme has the following Major:

- Mathematics (150 ECTS)

A student who desires to obtain two Bachelor's degrees in both Mathematics and Physics has to be enrolled in both degree programmes. The learning outcomes of both programmes are met by combining a predetermined set of courses with a total workload of 250 ECTS. See the document "Appendix for the double Bachelor's degree programme in Mathematics and Physics" for further details.

The degree programme has the following choices in Minors (30 ECTS):

- Minor Mathematics (see Appendix IV)
- Faculty-wide deepening minors
- University-wide broadening minors
- Education minor
- Minor at another university (national or abroad), to be approved by the Board of Examiners
- Personal minor based on an individual choice of course units (to be approved by the Board of Examiners)

The minor space of the degree programme does *not* offer the possibility of a research traineeship or a placement/internship.

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Appendix III Course units in the first year of the degree programme

- **List of course units (Article 4.1.1 and 9.4.3)**
- **Compulsory order of examinations (Article 9.3)**

First year degree programme Mathematics

The first year of the Bachelor's degree programme in Mathematics comprises a compulsory programme of 60 ECTS.

Course unit name	**Course code**	**ECTS**	**Entry requirements**
Calculus 1	WBMA003-05	5	
Linear Algebra 1	WBMA020-05	5	
Sets and Numbers	WBMA051-05	5	
Analysis	WBMA012-05	5	
Introduction to Graph Theory	WBMA052-05	5	
Calculus 2	WBMA029-05	5	
Scientific Programming	WBMA053-05	5	
Linear Algebra 2	WBMA035-05	5	
Mechanics and Relativity for Mathematicians	WBMA060-05	5	
Linear Systems	WBMA043-05	5	
Probability Theory	WBMA046-05	5	
One out of: - First-year Project Mathematics - First-year Project Applied Mathematics	 WBMA041-05 WBMA040-05	5	

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Appendix IV Course units in the second and third year of the degree programme

- **List of course units (Article 7.1.1 and 9.4.3)**
- **Compulsory order of examinations (Article 9.3)**

Second and third year Bachelor's programme in Mathematics
The second and third year of the programme consists of a list of compulsory major courses (90 ECTS) and a minor (30 ECTS).

Compulsory major courses

Course unit name	**Course code**	**ECTS**	**Entry requirements**
Group Theory	WBMA005-05	5	
Metric and Topological Spaces	WBMA036-05	5	
Statistics	WBMA009-05	5	
Complex Analysis	WBMA018-05	5	
Multivariable Analysis	WBMA022-05	5	
Geometry	WBMA034-05	5	
Functional Analysis	WBMA033-05	5	
Numerical Analysis	WBMA062-05	5	
Partial Differential Equations	WBMA008-05	5	
Mathematics & Society: Ethical and Professional Aspects	WBMA049-05	5	
Preparation Bachelor's Project	WBMA056-05	5	
Two out of: - Dynamical Systems - Algebraic Structures - Discrete Mathematics - Probability and Measure	 WBMA031-05 WBMA039-05 WBMA025-05 WBMA024-05	10	
One out of: - Project Statistical Reasoning (27/28) - Introduction to Coding Theory (27/28) - Introduction to Cryptography (26/27) - Project Chaos Theory (26/27)	 WBMA038-05 WBMA065-05 WBMA066-05 WBMA025-05	5	
1 elective course unit (see below)		5	
Bachelor's Project Mathematics	WBMA902-15	15	Passed 150 EC of the Bachelor's programme in Mathematics, including Preparation Bachelor's Project.

			Approval of study programme by BOE. Approval of Career Portfolio and enrolment Bachelor's Project Mathematics in Progress.

Minor space
The degree programme has the following choices in Minors (30 ECTS):

- Minor Mathematics (see table below for details)
- Faculty-wide deepening minors
- University-wide broadening minors
- Education minor
- Minor abroad (to be approved by the Board of Examiners)
- Personal minor based on an individual choice of course units (to be approved by the Board of Examiners)

Minor Mathematics
The Minor Mathematics (30 ECTS) consists of the following course units:

Course unit name	**Course code**	**ECTS**	**Entry requirements**
1 elective course unit (see below)		5	
Three out of: - Project Number Theory - Percolation Theory - Algebraic Topology - Introduction to Optimization	 WBMA064-05 WBMA059-05 WBMA058-05 WBMA054-05	15	
Two out of: - Analysis on Manifolds - Advanced Algebraic Structures ~~- Discrete Mathematics~~ - Stochastic Processes - Statistical Modelling - Philosophy of Mathematics	 WBMA013-05 WBMA011-05 ~~WBMA019-05~~ WBMA048-05 WBMA028-05 FI213BK	10	

Elective course units from Mathematics & Applied Mathematics

Elective course units can be chosen from the compulsory major courses in Mathematics, the compulsory major courses in Applied Mathematics and the Minor Mathematics as long as they are not otherwise part of the student's programme.

Course unit name	Course code	ECTS	Entry requirements
Project Systems Theory	WBMA027-05	5	
Differential Equations in Science and Engineering	WBMA061-05	5	
Project Mathematical Modelling	WBMA055-05	5	
Mathematical Modelling	WBMA007-05	5	
Computational Methods of Science	WBMA004-05	5	
Advanced Systems Theory	WBMA001-05	5	
Numerical Linear Algebra	WBMA063-05	5	
Discrete Mathematics	WBMA019-05	5	
Probability and Measure	WBMA024-05	5	
Stochastic Processes	WBMA048-05	5	
Project Statistical Reasoning (27/28)	WBMA038-05	5	
Statistical Modelling	WBMA028-05	5	
Dynamical Systems	WBMA031-05	5	
Algebraic Structures	WBMA039-05	5	
Introduction to Cryptography (26/27)	WBMA066-05	5	
Introduction to Coding Theory (27/28)	WBMA065-05	5	
Project Chaos Theory (26/27)	WBMA025-05	5	
Analysis on Manifolds	WBMA013-05	5	
Advanced Algebraic Structures	WBMA011-05	5	
Project Number Theory	WBMA064-05	5	
Percolation Theory	WBMA059-05	5	
Algebraic Topology	WBMA058-05	5	
Introduction to Optimization	WBMA054-05	5	

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Elective course units from other degree programmes
The following elective course units from other degree programmes can be chosen.

Course unit name	Course code	ECTS	Entry requirements
Teach Like a Scientist	WBEC004-05	5	
One out of: - Oriëntatie op Onderwijs in de Bètawetenschappen (in Dutch) - Introduction to Science Communication	 WBEC002-05 WBEC001-05	5	
One out of: - Functional Programming - C++ fundamentals	 WBCS002-05 WBCS033-05	5	
One out of: - Object-Oriented Programming (for CS) - Object-Oriented Programming (for AI)	 WBCS028-05 WBAI045-05	 5 5	
Programming in C++	WBCS034-05	5	
Symmetry in Physics	WBPH047-05	5	
Quantum Physics 1	WBPH014-05	5	
Statistical Signal Processing	WBAS009-05	5	
Dynamic Econometrics	EBB813A05	5	
Game Theory	EBB872A05	5	
Risk Insurance	EBB863A05	5	
One out of: - Life Insurance - Introduction to Econometrics	 EBB827B05 EBB828A05	5	

Appendix V Contact hours (Article 3.6.1)

Degree programme year 1	
Structure contact hours	**Contact hours per year**
Lectures	352
Tutorials	320
Practicals	24
Computer practicals	32
Study support/mentor groups	70
Supervision during an internship	
Examinations	50
Misc. contact hours (seminars and symposia)	20

Degree programme year 2 and 3	
Structure contact hours	**Contact hours per year**
Lectures	384
Tutorials	384
Practicals	48
Computer practicals	64
Study support/mentor groups	
Supervision during an internship	
Examinations	40
Misc. contact hours (seminars and symposia)	20

Note: contact hours in year 2 and 3 might deviate from the table above due to choices of the Minor and elective courses.

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Appendix VI Additional Requirements Open Degree Programmes (Article 7.3)

Students wishing to pursue an open degree programme may file a request with the Board of Examiners. An Open Degree Programme must always be approved in advance by the Board of Examiners. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme and can determine further conditions in their rules and regulations.

The Open Degree Programme in Mathematics must include all compulsory courses units from year 1 (see appendix III) and the following course units from year 2 and 3:

Course unit name	**Course code**	**ECTS**	**Entry requirements**
Group Theory	WBMA005-05	5	
Metric and Topological Spaces	WBMA036-05	5	
Statistics	WBMA009-05	5	
Complex Analysis	WBMA018-05	5	
Multivariable Analysis	WBMA022-05	5	
Geometry	WBMA034-05	5	
Functional Analysis	WBMA033-05	5	
Partial Differential Equations	WBMA008-05	5	
Mathematics & Society: Ethical and Professional Aspects	WBMA049-05	5	
Preparation Bachelor's Project	WBMA056-05	5	
Two out of: - Dynamical Systems - Algebraic Structures - Discrete Mathematics - Probability and Measure	 WBMA031-05 WBMA039-05 WBMA025-05 WBMA024-05	10	
Bachelor's Project Mathematics	WBMA902-15	15	Passed 150 ECTS of the Open Degree Programme in Mathematics, including the course Preparation Bachelor's Project. Approval of study programme by BOE Approval of Career Portfolio and enrolment Bachelor's Project Mathematics in Progress.

Appendix VII Transitional provisions (Article 12.1)

Since the TER for this academic year is applicable to all students registered in the Bachelor's degree programme in Mathematics, regardless of the starting date of students, transitional provisions are in place. Students who have already completed a discontinued course are excluded from taking the respective replacement course.

Discontinued elective courses
The course Advanced Logic (WBAI017-05) can formally no longer be chosen as an elective because the mandatory prerequisite course Introduction to Logic (WBAI012-05) is no longer included as an elective in the first-year. Students who passed the course Advanced Logic (WBAI017-05) before 1 September 2024 may still include this course as an elective in their programme.

For cohort 2023-2024 and earlier
The following courses have either been discontinued or their names have been changed and hence are considered equivalent. Therefore, students are not allowed to include both the old and new course in their programme. Students from cohort 2023-2024 and earlier may replace the discontinued/renamed course according to the table below, provided the discontinued/renamed course was passed before the indicated date.

Old course	**New course**
Introduction to Logic (if passed before September 1, 2024)	Mechanics and Relativity for Mathematicians
Numerical Mathematics 1 (if passed before September 1, 2025)	Numerical Analysis
Numerical Mathematics 2 (if passed before September 1, 2025)	Numerical Linear Algebra
Project Security and Coding (if passed before September 1, 2025)	Introduction to Coding Theory *or* Introduction to Cryptography
Elementary Number Theory (if passed before September 1, 2025)	Project Number Theory
Philosophy of Science (if passed before September 1, 2024)	Philosophy of Mathematics

For information on transitional arrangements for courses offered by other degree programmes, see also the Teaching and Examination Regulations of the corresponding programme.