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

2022-2023

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

Objectives of BSc Applied Mathematics

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 (applied) mathematicians.

The Bachelor's degree programme in Applied Mathematics aims to impart knowledge, skills, understanding and an academic attitude in the field of applied 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 Applied Mathematics. Graduates of the Bachelor's degree programme in Applied Mathematics should also be able to take the Master's degree programme in Mathematics or in Education and Communication.

Learning outcomes BSc Applied 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 Applied Mathematics

A1. have general knowledge of the foundations and principle branches of (applied) mathematics.

A2. have mastered the basic concepts of applied mathematics (see Appendix I for further specification) to a certain extent and are familiar with the interrelationships of these concepts within mathematics and applied mathematics as well as with other disciplines (e.g. in science and engineering).

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

A4. are familiar with the quantitative character of applied mathematics and have an understanding of the mathematical methods used in various areas of application, particularly including computer-aided methods.

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

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

B. Generic learning outcomes – Skills

Bachelor's graduates in Applied 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 and to evaluate the value and limitations of their research and assess its applicability outside their own field. See Appendix II for further specification.

B2 (Designing and Modelling) are able to translate a problem, in particular a design problem, into a plan of approach and – taking into account requirements and/or technical preconditions – find a solution.

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 in teams on technical-scientific problems, are able to work on (interdisciplinary) projects, taking responsibility for their (mathematical) contributions.

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 scientists and engineers. 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 and engineering 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 Applied 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 applied analysis, numerical mathematics, dynamical systems and systems theory.
1.3. have knowledge of more advanced topics in the fields of Computational Mathematics, and Systems and Control.
1.4. have gained knowledge of and experience in the 'heart' of mathematics, i.e., the truth and value of exact mathematical proof.
1.5. have knowledge of basic sciences at a level necessary to apply mathematical methods, and are aware of the wider multidisciplinary context of science and engineering
1.6. are able to use mathematical software packages in an effective way or, if necessary, modify programs themselves.

Appendix II Specified skills related learning outcomes

Bachelor's graduates in Applied 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) problems in the mathematical language, pose relevant mathematical questions and address them in an exact way, and if necessary, adapt the problem to make it mathematically 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 model, analyse and abstract simple problems that are outside the scope of their own study programme and to independently acquire new knowledge to this end.

Designing and 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 formulate concrete problems from application areas as mathematical problems, and are able to discuss the assumptions underlying their mathematical model.

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 abstracting and modelling, 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 numerical simulations and mathematical analysis in order to study problems in science and engineering.

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

The degree programme has the following Major:

- Applied Mathematics (150 ECTS)

The degree programme has the following Minor(s):

- a compulsory deepening minor in Applied Mathematics (30 ECTS)

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Appendix III Course units in the propaedeutic phase

- **List of course units; Article 4.1.1**
- **Compulsory order of examinations; Article 9.3**

The propaedeutic phase of the Bachelor's degree programme in Applied Mathematics comprises a compulsory programme and two electives.

Course unit name	Course code	ECTS	Practical	Entry requirements
Calculus 1	WBMA003-05	5	PR	
Linear Algebra 1	WBMA020-05	5	PR	
Sets and Numbers	WBMA051-05	5		
Analysis	WBMA012-05	5		
Introduction to Graph Theory	WBMA052-05	5		
Elective 1 (see electives below)		5		
Calculus 2	WBMA029-05	5		
Scientific Programming	WBMA053-05	5	PR	
Linear Algebra 2	WBMA035-05	5		
Linear Systems	WBMA043-05	5		
Probability Theory	WBMA046-05	5		
Elective 2 (see electives below)		5		

Electives, year 1

Course unit name	Course code	ECTS	Practical	Entry requirements
Elective 1, one out of: - Introduction to Logic - Mechanics and Relativity for Mathematicians	 WBAI013-05 WBMA060-05	5		 - -
Elective 2, one out of: - First-year Project Mathematics - First-year Project Applied Mathematics	 WBMA041-05 WBMA040-05	5	PR	 - -

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Appendix IV Course units in the post-propaedeutic phase

- **List of course units; Article 7.1.1**
- **Compulsory order of examinations; Article 9.3**

The post-propaedeutic programme consists of a major (90 ECTS) and deepening minor Applied Mathematics (30 ECTS).

Compulsory major courses

Course unit name	Course code	ECTS	Practical	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	WBMA018-05	5		
Dynamical Systems	WBMA031-05	5		
Project Systems Theory	WBMA027-05	5	PR	
Differential Equations in Science and Engineering	WBMA061-05	5		
Functional Analysis	WBMA033-05	5		
Numerical Mathematics 1	WBMA045-05	5	PR	
Partial Differential Equations	WBMA008-05	5		
Mathematical Modelling	WBMA007-05	5		
Mathematics & Society: Ethical and Professional Aspects	WBMA049-05	5		
Elective (see optional course units below)		5		
Preparation Bachelor's Project	WBMA056-05	5		
Bachelor's Project Applied Mathematics	WBMA901-15	15	PR	Passed 150 ECTS of the Bachelor's programme in Mathematics, including Preparation Bachelor's Project

Compulsory minor courses

Course unit name	Course code	ECTS	Practical	Entry requirements
Numerical Mathematics 2	WBMA023-05	5	PR	
Introduction to Optimization	WBMA054-05	5		
Project Mathematical Modelling	WBMA055-05	5	PR	
Two out of - Computational Methods of Science - Advanced Systems Theory - Statistical Modelling	 WBMA004-05 WBMA001-05 WBMA028-05	15	 PR PR	
Elective (see optional course units below)				

Elective course units from Applied Mathematics
Elective course units can be chosen from the post-propaedeutic courses of the Bachelor's programme in Applied Mathematics as long as they are not otherwise part of the student's programme.

Course unit name	Course code	ECTS	Practical	Entry requirements
Computational Methods of Science	WBMA004-05	5	PR	-
Advanced System Theory	WBMA001-05	5		-
Statistical Modelling	WBMA028-05	5	PR	-

Elective course units from Mathematics
Elective course units can be chosen from the post-propaedeutic courses of the Bachelor's programme in Mathematics as long as they are not otherwise part of the student's programme.

Course unit name	Course code	ECTS	Practical	Entry requirements
Geometry	WBMA034-05	5		-
Project Security and Coding	WBMA026-05	5	PR	-
Project Chaos Theory	WBMA025-05	5	PR	-
Algebraic Structures	WBMA039-05	5		-
Analysis on Manifolds	WBMA013-05	5		-
Advanced Algebraic Structures	WBMA011-05	5		-
Discrete Mathematics	WBMA019-05	5		-
Probability and Measure	WBMA024-05	5		-
Stochastic Processes	WBMA048-05	5		-
Project Statistical Reasoning	WBMA038-05	5	PR	-
Elementary Number Theory	WBMA057-05	5		
Percolation Theory	WBMA059-05	5		
Algebraic Topology	WBMA058-05	5		

In addition, the electives can be chosen from the following list of courses:

Course unit name	Course code	ECTS	Practical	Entry requirements
One out of: - Imperative Programming - C++ fundamentals	 WBCS003-05 WBCS033-05	 5 5	PR	 - -
Programming in C++	WBCS034-05	5	PR	-
Mechatronics	WBIE011-05	5		-
Electronics & Signal Processing	WBPH038-05	5		-
Astrophysical Hydrodynamics	WBAS011-05	5		-
Physics of Fluids	WBPH042-05	5		
Philosophy of Science	FI180WET	5		-
Introduction to Science and Education (Dutch)	WBEC002-05	5		-

Appendix V Admission to the post-propaedeutic phase (Article 6.1.1)

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

a. Students who have been issued a positive study advice from the degree programme in question.
b. Students who have been issued a positive study advice from one of the degree programme in Mathematics.

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Appendix VI Contact hours propaedeutic and post-propaedeutic phase (Article 3.6)

Degree programme year 1	
Structure contact hours	**Contact hours per year**
Lectures	335
Tutorial	290
Practical	25
Computer practical	40
Study support/Mentor groups	70
Supervision during an internship	-
Examinations	80
Misc. contact hours (symposia)	20

Degree programme post-propaedeutic	
Structure contact hours	**Contact hours per year**
Lectures	620
Tutorial	450
Practical	40
Computer practical	70
Study support/Mentor groups	-
Supervision during an internship	10
Examinations	240
Misc. contact hours (symposia)	30

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Appendix VII Additional Requirements Open Degree Programmes (Art. 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 Applied Mathematics must include the following course units:

Course unit name	Course code	ECTS	Practical	Entry requirements
Project Systems Theory	WBMA027-05	5	PR	
Differential Equations in Science and Engineering	WBMA061-05	5		
Functional Analysis	WBMA033-05	5		
Numerical Mathematics 1	WBMA045-05	5	PR	
Partial Differential Equations	WBMA008-05	5		
Mathematical Modelling	WBMA007-05	5		
Mathematics & Society: Ethical and Professional Aspects	WBMA049-05	5		
Introduction to Optimization	WBMA054-05	5		
Project Mathematical Modelling	WBMA055-05	5	PR	
Two out of - Computational Methods of Science - Advanced Systems Theory - Statistical Modelling	 WBMA004-05 WBMA001-05 WBMA028-05	10	 PR PR	
Preparation Bachelor's Project	WBMA056-05	5		
Bachelor's Project Applied Mathematics	WBMA901-15	15	PR	Passed 150 ECTS of the Bachelor's programme in Mathematics, including Preparation Bachelor's Project

Appendix VIII 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 Applied Mathematics, regardless of the starting date of students, transitional arrangements are in place.

The propaedeutic phase of the 2022/23 curriculum has three new compulsory course units. The course Sets and Integers replaces Kaleidoscope Mathematics. The course Scientific Programming replaces Computer-Aided Problem Solving. Students from the cohort 2021/22 and earlier may take Kaleidoscope Mathematics instead of Sets and Integers and Computer-Aided Problem Solving instead of Scientific Programming provided they have passed the (discontinued) replacement courses before September 1, 2022. The course Mechanics and Relativity 1 is no longer part of the programme. Students from the cohort 2021/22 and earlier who have passed Mechanics and Relativity 1 before September 1, 2022 may replace Introduction to Graph Theory with Mechanics and Relativity 1. In summary:

For cohort 2021-2022 and earlier

Old Course	**New Course**
Kaleidoscope Mathematics	Sets and Numbers
Mechanics and Relativity 1	Introduction to Graph Theory
Mechanics and Relativity 2	Mechanics and Relativity for Mathematicians
Computer-Aided Problem Solving	Scientific Programming

In the post-propaedeutic phase, the following substitutions are allowed (provided the (discontinued) replacement course is passed before September 1, 2022):

For cohort 2021-2022 and earlier

Old Course	**New Course**
Fluid Dynamics	Differential Equations in Science and Engineering
Bachelor's Workgroup Mathematics	Preparation Bachelor's Project
Calculus of Variation and Optimal Control	Introduction to Optimization
Project Modelling	Project Mathematical Modelling

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