university of groningen / faculty of science and engineering

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

2021-2022

Appendix I Learning outcomes of the degree programme (art. 3.1)

Objective of MSc Applied Mathematics
As a consequence of the ongoing automation of society and the technological innovations that go along with it, 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 master's degree programme in Applied Mathematics aims to train mathematicians who meet this profile.

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

Learning outcomes MSc Applied Mathematics
The above objective has been translated into a set of learning outcomes for the programme. The learning outcomes consist of general learning outcomes with respect to both knowledge and skills (which are applicable for the Master's degree programme in Mathematics as well) which are supplemented with programme-specific learning outcomes. For each learning outcome a reference to the Dublin descriptors is given between brackets.

The master graduate in Applied Mathematics:

A1. has an understanding of the most important concepts of the field, [applying knowledge and understanding]
A2. is able to contribute to the scientific advancement of a subfield of applied mathematics, [applying knowledge and understanding]
A3. is able to use abstract thinking and mathematical modelling to get to the root of a problem and thus recognize whether existing methods are applicable, or to ascertain that new methods must be developed, [applying knowledge and understanding]
A4. is able to function in multidisciplinary teams, [applying knowledge and understanding]
A5. is familiar with the social and ethical aspects of applying mathematics in practice, [judgement]
A6. understands the scientific relevance of problem definitions and results, and the validity of the scientific method, [judgement]
A7. is able to communicate effectively ideas, problems and solutions with the mathematical, science and engineering communities. [communication]
A8. is able to express him- or herself well both orally and in writing, [communication]
A9. is able to evaluate the scientific literature so as to keep their knowledge up to date. [learning]

In addition, the master graduate in Applied Mathematics:

T1. has general knowledge of the theories, methods and techniques in the field of applied mathematics, [knowledge and understanding]
T2. has specialized knowledge in at least one of the following subfields of applied mathematics: [knowledge and understanding]
    a. Computational Mathematics
    b. Systems and Control,
T3. has wide experience with the mathematical modelling of problems from actual practice, [applying knowledge and understanding]
T4. has extensive experience with using the relevant mathematical tools. [applying knowledge and understanding]

Appendix II Tracks/Specializations of the degree programme (art. 3.5 + 3.6)

The degree programme has the following tracks:

1. Computational Mathematics
2. Systems and Control

Appendix III Content of the degree programme (art. 3.7)

1. The programme for Computational Mathematics is:

Course unit	Course code	ECTS
Mathematics and its Environment	WMMA013-05	5
Mathematical Modelling Colloquium	WMMA023-05	5
Complexity and Networks	WMMA005-05	5
≥ 23 ECTS out of: - Computational Fluid Dynamics - Finite Element Modelling for Advanced Processing - Finite Element Methods for Fluid Dynamics - Numerical Bifurcation Analysis of Large Scale Systems (Mastermath) - Numerical Linear Algebra (Mastermath) - Relevant courses from the Mastermath programme (at the discretion of the Board of Examiners) Min. 3 courses have to be local non-Mastermath courses	 WMMA012-05 WMME013-05 WMMA016-05 WMMA014-08	 5 5 5 8 8 6/8
≥ 15 ECTS guided choice: have to be chosen from Electives below (see art. 3.7)		≥ 15
≤15 ECTS free choice: modules on Master level, relevant for Mathematics (at the discretion of the Board of Examiners)		≤15
Master Research Project in Applied Mathematics	WMMA901-35	35
Internship Applied Mathematics	WMMA001-15	15

The total has to be at least 120 ECTS, but it should not be possible to remove 1 course and still have more than 120 ECTS. At the discretion of the Board, these extra courses could be added as extracurricular.

2. The programme for Systems and Control is:

Course unit	Course code	ECTS
Mathematics and its Environment	WMMA013-05	5
Mathematical Modelling Colloquium	WMMA023-05	5
Complexity and Networks	WMMA005-05	5
≥ 23 ECTS out of: - Robust Control - Convex Optimization - Modeling and Identification	 WMMA021-05 WMMA006-05 WMMA007-05	 5 5 5

- Modeling and Control of Complex Nonlinear Engineering Systems - Systems and Control (Mastermath) - Relevant courses from the Mastermath programme (at the discretion of the Board of Examiners) Min. 3 courses have to be local non-Mastermath courses	WMMA020-05 WMMA003-06	5 6 6/8
≥ 15 ECTS guided choice: have to be chosen from Electives below (see art. 3.7)		≥ 15
≤15 ECTS free choice: modules on Master level, relevant for Mathematics (at the discretion of the Board of Examiners)		≤15
Master Research Project in Applied Mathematics	WMMA901-35	35
Internship Applied Mathematics	WMMA001-15	15

The total has to be at least 120 ECTS, but it should not be possible to remove 1 course and still have more than 120 ECTS. At the discretion of the Board, these extra courses could be added as extracurricular.

Appendix IV Electives (art. 3.8)

1. Optional modules in the programme for Computational Mathematics:

≤ 15 ECTS are free choice (at the discretion of the Board of Examiners)

≥ 15 ECTS are chosen from:

Course unit	**Course code**	**ECTS**
Programming in C++	WBCS034-05	5
Scientific Visualization	WMCS018-05	5
Computational Physics	WMPH007-05	5
Modelling and Simulation	WMCS003-05	5
Robust Control	WMMA021-05	5
Convex Optimization	WMMA006-05	5
Modeling and Identification	WMMA007-05	5
Modeling and Control of Complex Nonlinear Engineering Systems	WMMA020-05	5
Systems and Control (Mastermath)	WMMA003-06	6
Introduction to Data Science	WMCS002-05	5
Statistical Genomics	WMMA008-05	5
Caput Statistics	WMMA011-05	5
Contemporary Statistics with Applications	WMMA015-05	5
Statistical Consulting	WMMA024-05	5
Caput Dynamical Systems and Chaos	WMMA004-05	5
Caput Mathematical Physics	WMMA022-05	5
Hamiltonian Mechanics	WMMA019-05	5

Caput Algebra and Geometry	WMMA027-05	5
Caput Differential Geometry	WMMA010-05	5
Geometry and Topology	WMMA018-05	5
Geometry and Differential Equations	WMMA017-05	5
Caput Number Theory	WMMA025-05	5
Topics in Topology	WMMA026-05	5
Relevant courses from the Mastermath programme (at the discretion of the Board of Examiners)		6/8
Can only be followed together: - Basiscursus Master Lerarenopleiding (Dutch) - Masterstage 1 (Dutch)	 TEM0105 TEM0205	 5 5

2. Optional modules in the programme for Systems and Control:

≤ 15 ECTS are free choice (at the discretion of the Board of Examiners)

≥ 15 ECTS are chosen from:

Course unit	**Course code**	**ECTS**
Analysis and Control of Smart Systems	WMIE015-05	5
Robotics for IEM	WMIE005-05	5
Advanced Digital and Hybrid Control Systems	WMIE014-05	5
Computational Fluid Dynamics	WMMA012-05	5
Finite Element Modelling for Advanced Processing	WMME013-05	5
Finite Element Methods for Fluid Dynamics	WMMA016-05	5
Numerical Bifurcation Analysis of Large Scale Systems (Mastermath)	WMMA014-08	8
Numerical Linear Algebra (Mastermath)	WMMA002-08	8
Introduction to Data Science	WMCS002-05	5
Statistical Genomics	WMMA008-05	5
Caput Statistics	WMMA011-05	5
Contemporary Statistics with Applications	WMMA015-05	5
Statistical Consulting	WMMA024-05	5
Caput Dynamical Systems and Chaos	WMMA004-05	5
Caput Mathematical Physics	WMMA022-05	5
Hamiltonian Mechanics	WMMA019-05	5
Caput Algebra and Geometry	WMMA027-05	5
Caput Differential Geometry	WMMA010-05	5
Geometry and Topology	WMMA018-05	5
Geometry and Differential Equations	WMMA017-05	5
Caput Number Theory	WMMA025-05	5
Topics in Topology	WMMA026-05	5
Relevant courses from the Mastermath programme (at the discretion of the Board of Examiners)		6/8
Can only be followed together: - Basiscursus Master Lerarenopleiding (Dutch) - Masterstage 1 (Dutch)	 TEM0105 TEM0205	 5 5

For information on the modules of the Mastermath programme see http://elo.mastermath.nl.

For information on the modules of programmes of the University of Groningen other than the master's degree programme in Applied Mathematics see the Teaching and Examination Regulations of the corresponding programme.

Appendix V Entry requirements and compulsory order of examinations (art. 4.4)

The entry requirement for the Master Research Project in Applied Mathematics (35 ECTS) and Internship Applied Mathematics (15 ECTS) is a successful completion of 45 ECTS of modules of the master's degree programme in Applied Mathematics.

Appendix VI Admission to the degree programme and different specializations (art. 2.1.1 + art. 2.2)

Holders of the following Bachelor's degrees from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the master's degree programme in Applied Mathematics:

- BSc Mathematics
- BSc Applied Mathematics

Appendix VII Transitional arrangements (art. 7.1)

For all cohorts

Course	May be replaced with
Computational Mechanics 2 (WMME008-05)	Finite Element Modelling for Advanced Processing (WMME013-05)

For cohort 2020-2021 and earlier

Course	May be replaced with
Modeling of Fluid Flow	Computational Mechanics 2
Programming in C/C++ (part II)	Programming in C++

For cohort 2019-2020 and earlier

Course	May be replaced with
Modeling of Fluid Flow	Computational Mechanics 2

For cohort 2018-2019 and earlier

Course	May be replaced with
Reason Modelling of Fluid Flow as given in 2017-2018	Finite Element Methods for Fluid Dynamics as given in 2018-2019

Modelling of Fluid Flow as given in 2017-2018 and Finite Element Methods for Fluid Dynamics as given in 2018-2019 cannot both be part of the study programme of a student. Modelling of Fluid Flow as given in 2019-2020 will have a different content than the 2017-2018 version of the course.

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

Appendix VIII Application deadlines for admission (art. 2.6.1) and Additional requirements to Open Degree Programs (art. 5.6)

Deadline of Application	Non-EU students	EU students
Nanoscience	February 1st 2021	May 1st 2021
All other FSE Masters	May 1st 2021	May 1st 2021

Additional requirements to Open Degree Programs
In exceptional circumstances, students wishing to pursue an open degree programme may file a request with 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.

Decision deadlines (art. 2.6.3)

Deadline of Decision	Non-EU students	EU students
All FSE Masters	June 1st 2021	June 1st 2021

Appendix IX Selection criteria selective master's degree programmes

Not applicable.