university of groningen / faculty of mathematics and natural sciences

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

2015-2016

Appendix I Teaching outcomes of the degree programme (art. 1.3)

The learning outcomes consist of general learning outcomes with respect to both knowledge and skills, which are applicable for both the P-variant and M-variant, supplemented with variant-specific learning outcomes. For each learning outcome a reference to the Dublin descriptors is given between brackets.

The master graduate in Mathematics:

A1. has an understanding of the most important concepts of the field, [knowledge and understanding]
A2. is able to contribute to the scientific advancement of a subfield of 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 describe solutions in both general and formal mathematical terms, [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 Mathematics of the P-variant

P1. has specialized knowledge of theories, methods and techniques in at least one of the following subfields of mathematics: [knowledge and understanding]
    a. Algebra & Geometry
    b. Dynamical Systems and Analysis
    c. Statistics and Probability
P2. has experience with the mathematical modelling of non-mathematically formulated ideas and problems and with interpreting the mathematical results in the light of the original, non-mathematical problem, [applying knowledge and understanding]
P3. is able to apply scientific results and insights to concrete problems in mathematics or in related fields (natural sciences or applied mathematics), [applying knowledge and understanding]
P4. is familiar with and experiences mathematics as a coherent organic unit. [judgement]

Whereas the master graduate in Mathematics of the M-variant Science, Business and Policy:
(Since the Business and Policy part of the M-variant is taught in Dutch the M-variant specific learning outcomes are in Dutch).

M1. heeft inzicht in het functioneren van bedrijven en beleidsorganisaties (overheden en niet-gouvernementele organisaties, NGO's).
M2. heeft inzicht in de verbanden tussen natuurwetenschappelijk onderzoek, het bedrijfsleven en overheidsbeleid.
M3. is in staat natuurwetenschappelijke en bedrijf- en beleidsmatige aspecten te integreren, in concreto:
    (a) het kunnen vertalen van een concreet bedrijfs- of beleidsmatig probleem naar een natuurwetenschappelijk probleem
    (b) het kunnen relateren van natuurwetenschappelijke aspecten van een probleem aan andere relevante kennisvelden
    (c) het kunnen plaatsen van onderzoeksresultaten in een beleid- of bedrijfsmatige context

M4. beschikt over sociale en communicatieve vaardigheden, in concreto:
- (a) het kunnen schrijven van doelgerichte teksten
- (b) het kunnen opstellen van een innovatie- en beleidsplan voor respectievelijk een bedrijf of overheid
- (c) het kunnen houden van overtuigende mondelinge presentaties
- (d) een actieve bijdrage kunnen leveren aan plenaire discussies
- (e) vergadertechnieken beheersen, waaronder voorzitten
- (f) het kunnen werken aan een project in teamverband
- (g) het geven en ontvangen van feedback op het functioneren in een team

M5. is in staat projectmatig te werken, in concreto:
- (a) rekening kunnen houden met het belang of de doelstelling van een opdrachtgever
- (b) het zelfstandig kunnen plannen van een project
- (c) kunnen samenwerken met de voor het project relevante partijen
- (d) adequaat kunnen omgaan met beperkingen in tijd, informatie en middelen
- (e) het kunnen voorbereiden van de implementatie van een projectresultaat

M6. is in staat beroepsverantwoordelijkheid te nemen, in concreto:
- (a) het kunnen nemen van verantwoordelijkheid voor de organisatie
- (b) het kunnen herkennen van strategische aspecten van het eigen project
- (c) praktische invulling kunnen geven aan ethische beroepscodes van het eigen vakgebied en de organisatie

Appendix II Specializations of the degree programme (art. 2.2)

The degree programme has a P-variant and an M-variant with the following specializations:

P-variant:
- Algebra and Geometry
- Dynamical Systems and Analysis
- Statistics and Probability

M-variant:
- Science, Business and Policy

Appendix III Content of the degree programme (art. 2.3)

P-variant

The P-variant of the degree programme has the following specializations:

- Algebra and Geometry
- Dynamical Systems and Analysis
- Statistics and Probability

The master programme comprises 120 ECTS.

The requirements on the programme are the following.

Parts	*Constraints*	*ECTS*
Student colloquium		5
At least five modules from the list of modules given at the University of Groningen, the modules in the specialization area are compulsory	*Specialization Algebra and Geometry:* - Caput Algebra and Geometry (annual) - Geometry and Topology (every two years, 2015-2016) - Geometry and Differential Equations (every two years, 2016-2017) - Caput Differential Geometry (annual) *Specialization Dynamical Systems and Analysis:* - Dynamical Systems and Chaos (annual) - Caput Dynamical Systems (every two years, 2015-2016) - Caput Mathematical Physics (every two years, 2016-2017) -Hamiltonian Mechanics (annual) *Specialization Statistics and Probability:* - Contemporary Statistics with Applications (every two years, 2016-2017) - Statistical Genomics (every two years, 2015-2016) *Specialization Computational Science and Numerical Mathematics (Applied mathematics):* - Computational Fluid Dynamics (annual) - Computational Engineering (every two years , 2016-2017) - Boundary Layers (every two years, 2015-2016) *Specialization Systems, Control and Optimization (Applied mathematics):* - Robust Control (annual) - Modeling and Identification (every two years, 2016-2017) - Modeling and Control of Complex Nonlinear Engineering Systems (annual)	≥ 25

At least three modules from the Mastermath programme	From these modules at least two have to be in the specialization area and at least one has to be outside the specialization area. For information on the modules of the Mastermath programme see: www.mastermath.nl	≥18
Advanced modules of programmes taught at the University of Groningen other than the master programmes mathematics and applied mathematics	These modules have to be of at least third year bachelor level, and have to be relevant for the master Mathematics (at the discretion of the exam committee).	≤ 10
Free choice		≤ 5
Final Research Project	Research project in the specialization area.	50

M-variant

The M-variant of the degree programme is called *Science, Business and Policy*.
The master programme comprises 120 ECTS and consists of a mathematical component (60 ECTS) and a Business and Policy component (60 ECTS)

The requirements on the programme are the following.

Mathematical component (60 ECTS)		
Parts	*Constraints*	*ECTS*
At least three modules from the list of modules given at the University of Groningen. At least two modules have to be chosen from the modules of the specialization area.	*Specialization Algebra and Geometry:* - Caput Algebra and Geometry (annual) - Geometry and Topology (every two years, 2015-2016) - Geometry and Differential Equations (every two years, 2016-2017) - Caput Differential Geometry (annual) *Specialization Dynamical Systems and Analysis:* - Dynamical Systems and Chaos (annual) - Caput Dynamical Systems (every two years, 2016-2017) - Caput Mathematical Physics (every two years, 2015-2016) - Hamiltonian Mechanics (annual)	≥ 15

	Specialization Statistics and Probability: - Contemporary Statistics with Applications (every two years, 2016-2017) - Statistical Genomics (every two years, 2015-2016) *Specialization Computational Science and Numerical Mathematics:* - Computational Fluid Dynamics (annual) - Computational Engineering (every two years , 2016-2017) - Boundary Layers (every two years, 2015-2016) *Specialization Systems, Control and Optimization:* - Robust Control (annual) - Modeling and Identification (every two years, 2016-2017) - Modeling and Control of Complex Nonlinear Engineering Systems (annual)	
At most three modules from the Mastermath programme	For information on the modules of the Mastermath programme see: www.mastermath.nl	≤ 18
Advanced modules of programmes taught at the University of Groningen other than the master programmes mathematics and applied mathematics	These modules have to be of at least third year bachelor level, and have to be relevant for the master Mathematics (at the discretion of the exam committee).	≤ 10
Mathematical Research Project	Research project in the specialization area.	30

Business and Policy component (60 ECTS)		
Parts	*Constraints*	*ECTS*
Module Science, Business and Policy		20
Internship Science, Business and Policy		40

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

For information on the modules of programmes of the University of Groningen other than the master programmes mathematics and applied mathematics see the teaching and examination regulations of the corresponding programme.

Double master's degree in Physics and Mathematics
For students who want to combine the master's programme in Physics and Mathematics the following programme is in place. In case the student is enrolled in both programmes, the student is awarded a master's degree in both Physics and Mathematics after completing the total programme. The total programme comprises 165 ects, 95 ects of courses and 70 ects of research, and is feasible within 2 ½ year of study.

<table>
<tr><th>Master Physics</th><th>Master Mathematics</th></tr>
<tr><td>Core Physics (20 ects)

- Advanced Quantum Mechanics
- Computational Physics
- Statistical Mechanics
- Mathematical Methods of Physics</td><td rowspan="2">RUG Math courses and Mastermath courses

45 ects of (Applied) Mathematics master courses, at least 6 of the RUG courses of the specialization areas Algebra & Geometry and Dynamical Systems & Analysis are compulsory:
Algebra & Geometry courses
- Caput Algebra & Geometry
- Geometry & Topology
- Geometry & Differential Equations
- Caput Differential Geometry
Dynamical Systems & Analysis courses
- Dynamical Systems and Chaos
- Caput Dynamical Systems
- Caput Mathematical Physics
- Hamiltonian Mechanics</td></tr>
<tr><td>Core QU (20 ects)

- General Relativity
- Particle Physics Phenomenogy
- Electrodynamics of Radiation Processes
- Student Seminar Quantum Universe</td></tr>
<tr><td>Optional Courses QU (10 ects)
- two optional courses QU which are not part of the individual mathematics programme of the student</td><td>Student Seminar Quantum Universe (5 ects)</td></tr>
<tr><td>Joint Research Project (70 ects)</td><td>Joint Research Project (70 ects)</td></tr>
</table>

For information about the courses of the master's degree programme Physics and a list of optional courses QU see the Teaching and Examination Regulations of the master's degree programme in Physics.

The Mathematics and Applied Mathematics modules given at the University of Groningen are

module	offered	ECTS	practical
Caput Algebra and Geometry	annual	5	
Geometry and Topology	every two years	5	
Geometry and Differential Equations	every two years	5	
Caput Differential Geometry	annual	5	
Boundary Layers	every two years	5	x
Caput Dynamical Systems	every two years	5	
Caput Mathematical Physics	every two years	5	
Computational Engineering	every two years	5	x
Computational Fluid Dynamics	annual	5	x
Contemporary Statistics with Applications	every two years	5	
Dynamical Systems and Chaos	annual	5	
Hamiltonian Mechanics	annual	5	
Final Research Project (P-variant only)	annual	50	
Mathematical Research Project (M-variant only)	annual	30	
Modelling and Identification	every two years	5	
Modeling and Control of Complex Nonlinear Engineering Systems	annual	5	
Robust Control	annual	5	
Statistical Genomics	every two years	5	
Student Colloquium	annual	5	

The modules of the Business and Policy component are

module	offered	ECTS	practical
Science, Business and Policy	annual	20	
Internship Science, Business and Policy	annual	40	

Appendix IV Electives (art. 2.4)

See Appendix III.

Appendix V Entry requirements and compulsory order of examinations (art. 3.2)

The entry requirement for the Final Research Project (50 ects) is a successful completion of 45 ects of modules of the master's degree programme in Mathematics.

The entry requirement for the internship Science, Business and Policy is a successful completion of the module Science, Business and Policy (20 ECTS) and the mathematical research project (30 ECTS).

Appendix VI Admission to the degree programme and different specializations (art. 4.1.1 + art. 4.2)

Holders of the following Bachelor's degree from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the Master's degree programme in Mathematics on that basis:

- BSc Mathematics
- BSc Applied Mathematics

Appendix VII

Application deadlines for admission (art. 4.6.1)

Deadline of Application	**Non-EU students**	**EU students**
Nanoscience	February 1st 2016	February 1st 2016
Behavioural and Cognitive Neurosciences	May 1st 2016	May 1st 2016
Biomolecular Sciences (topprogramme)	May 1st 2016	May 1st 2016
Evolutionary Biology (topprogramme/EM)	January 15th 2016	January 15th 2016
Remaining FMNS Masters (amongst which Mathematics)	May 1st 2016	May 1st 2016

Decision deadlines (art. 4.6.3)

Deadline of Decision	**Non-EU students**	**EU students**
Nanoscience	June 1st 2016	June 1st 2016
Behavioural and Cognitive Neurosciences	June 1st 2016	June 1st 2016
Biomolecular Sciences (topprogramme)	June 1st 2016	June 1st 2016
Evolutionary Biology (topprogramme/EM)	June 1st 2016	June 1st 2016
Remaining FMNS Masters (amongst which Mathematics)	June 1st 2016	June 1st 2016