



Assessment plan for the curriculum of the Master's degree programme in Mathematics, 2023-2024

Introduction

This assessment plan is a systematic description of the testing and assessment modes for all study components in the curriculum of the Master's degree programme in Mathematics, 2023-2024. The plan is based on the assessment policy of the Faculty of Science and Engineering, as set out in the 2016-2017 version of the FMNS Quality Assurance Manual (Chapter 6: Assessment) and the protocol setting out the duties and powers of the Faculty's Board of Examiners (December 2013).

The assessment plan for the curriculum consists of the following parts:

1. objective(s) of the degree programme
2. the learning outcomes of the degree programme
3. descriptions of the study components, as set out in the appendices to the Teaching and Examination Regulations 2023-2024 of the degree programme
4. descriptions of the content of each study component in Ocasys, the online course catalogue. The following elements are relevant in this context:
 - objectives
 - description of content
 - lecturers
 - assessment mode(s) and calculation of final mark
 - mode(s) of instruction.
5. An overview of the examiners and a detailed assessment mode for each study component. This overview is based on the curriculum approved by the Programme Committee, as set out in the appendices to the Teaching and Examination Regulations 2023-2024 for the degree programme.
6. A matrix showing the relationship between the study components and the detailed learning outcomes for each competence area.

Parts 3 and 4 are not included in this document. For the descriptions of the study components, see the Appendix to the Teaching and Examination Regulations 2023-2024 for the degree programme in Mathematics. Descriptions of the content of each study component can be found in Ocasys, the online course catalogue (<http://www.rug.nl/ocasys/>).

1. Objectives of the degree programme

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 Mathematics aims to train mathematicians who meet this profile.

The master'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 building on a bachelor's degree in Mathematics, such that Master'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.

2. Learning outcomes of the degree programme

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 all tracks of the programme, supplemented with track-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 reasoning 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, except for the track Science, Business and Policy,

- P1. has specialized knowledge of theories, methods and techniques in at least one of the following subfields of mathematics: [knowledge and understanding]
 - a. a. Number Theory and Algebraic Geometry
 - b. b. Probability and Discrete Mathematics

- c. c. Analysis and Dynamical Systems
- d. d. Geometry and Topology
- e. e. Mathematical Physics

- P2. has experience with formulating ideas and problems in the mathematical language 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 track Science, Business and Policy

- M1. has an understanding of the way in which businesses and policy organizations are functioning (governments and non-governmental organizations, NGO's) [knowledge and understanding]
- M2. understands the connections between natural science research, business, and policy [knowledge and understanding]
- M3. Is able to integrate aspects of natural science, business and management [applying knowledge and understanding]
- M4. has developed his/her social and communicative skills, is able to work project-based, and is capable of taking professional responsibility [communication, judgement]

3. Descriptions of the study components

For the descriptions of the study components, see the Appendix to the Teaching and Examination Regulations 2023-2024 for the degree programme in Mathematics.

4. Descriptions of the content of each study component

Descriptions of the content of each study component can be found in Ocasys, the online course catalogue (<http://www.rug.nl/ocasys/>).

5. Overview of examiners and testing and assessment modes for study components

In this section an overview of the examiners and a detailed assessment mode for each study component is given. This overview is based on the curriculum approved by the Programme Committee, as set out in the appendices to the Teaching and Examination Regulations 2018-2019 for the degree programme.

The abbreviations for the relevant modes of assessment:

- Written exam with open questions (WE)
- Oral exam (OR)
- Assignment (AST)
- Practical Work (PR)
- Presentation (P)
- Report (R)
- Interim test (IT)

The Mathematics modules offered locally at the University of Groningen are:

Module	Course code	Offered	ECTS	First examiner	Second examiner (if necessary)	Practical	Assessment type
<i>Specialization: Probability and Discrete Mathematics</i>							
Topics in Probability and Statistics	WMMA039-05	annual	5	dr. W.P. Krijnen	prof.dr. P. Trapman		R, P
Random Geometry and Topology A (24/25)	WMMA041-05	biennial	5	tbd in 24/25	tbd in 24/25		
Random Geometry and Topology B (23/24)	WMMA049-05	biennial	5	dr. R. Szabó	prof.dr. J.P. Trapman		AST, WE
Mathematical Modelling and Statistical Analysis of the Spread of Infectious Diseases (23/24)	WMMA061-05	biennial	5	prof.dr. P. Trapman	dr. R. Szabó		P, WE
Combinatorial Mathematics A (24/25)	WMMA036-05	biennial	5	tbd in 24/25	tbd in 24/25		AST, WE
Combinatorial Mathematics B (23/24)	WMMA046-05	biennial	5	dr. S. Donderwinkel	prof.dr. T. Müller		AST, WE
Modal Logic and Proof Theory	WMCS027-05	annual	5	See MSc CS	See MSc CS		AST

Specialization: Number Theory and Algebraic Geometry							
Introduction to Algebraic Geometry	WMMA033-05	annual	5	prof.dr. C. Salgado	prof.dr. J. Top		OR
Geometry and Topology (23/24)	WMMA018-05	biennial	5	dr. A.V. Kiselev	prof.dr. J. Top		AST, WE
Topics in Algebra and Geometry A (24/25)	WMMA038-05	biennial	5	tbd in 24/25	tbd in 24/25		AST, OR
Topics in Algebra and Geometry B (23/24)	WMMA048-05	biennial	5	prof.dr. J. Top	prof.dr. C. Salgado		AST, OR
Arithmetic Geometry (23/24)	WMMA045-05	biennial	5	dr. S. Muller	prof.dr. J. Top		AST, OR
Topics in Number Theory (24/25)	WMMA035-05	biennial	5	tbd in 24/25	tbd in 24/25		AST, OR
Specialization: Analysis and Dynamical Systems							
Perturbation Theory (24/25)	WMMA032-05	biennial	5	tbd in 24/25	tbd in 24/25		PR, WE
Singularity Theory (23/24)	WMMA043-05	biennial	5	dr. N. Martynchuk	prof.dr. H. Waalkens		AST, P
Topics in Dynamical Systems and Chaos A (24/25)	WMMA031-05	biennial	5	tbd in 24/25	tbd in 24/25		AST, OR
Topics in Dynamical Systems and Chaos B (23/24)	WMMA042-05	biennial	5	dr. A.E. Sterk	dr. H. Jardon Kojakhmetov		AST, OR
Integrable Systems	WMMA037-05	annual	5	dr. T.F. Görbe	dr. N. Martynchuk		P, AST
Spectral Theory (23/24)	WMMA047-05	biennial	5	dr. M. Seri	prof.dr. H. Waalkens		AST, OE
Geometry and Differential Equations (24/25)	WMMA017-05	biennial	5	tbd in 24/25	tbd in 24/25		WE
Specialization: Geometry and Topology							
Introduction to Algebraic Geometry	WMMA033-05	annual	5	prof.dr. C. Salgado	prof.dr. J. Top		OR
Geometry and Topology (23/24)	WMMA018-05	biennial	5	dr. A.V. Kiselev	prof.dr. J. Top		AST, WE
Integrable Systems	WMMA037-05	annual	5	dr. T.F. Görbe	dr. N. Martynchuk		P, AST
Topics in Differential Geometry	WMMA040-05	annual	5	dr. N. Martynchuk	prof.dr. G. Vegter	x	AST, P
Geometry and Differential Equations (24/25)	WMMA017-05	biennial	5	tbd in 24/25	tbd in 24/25		WE

Topics in Topology A (24/25)	WMMA034-05	biennial	5	tbd in 24/25	tbd in 24/25		AST, OR
Topics in Topology B (23/24)	WMMA044-05	biennial	5	dr. R. van der Veen	dr. A.V. Kiselev		AST, P
Specialization: Mathematical Physics							
Hamiltonian Mechanics	WMMA019-05	annual	5	dr. H. Jardon Kojakhmetov	dr. M. Seri		AST, P, R
Perturbation Theory (24/25)	WMMA032-05	biennial	5	tbd in 24/25	tbd in 24/25		PR, WE
Singularity Theory (23/24)	WMMA043-05	biennial	5	dr. N. Martynchuk	prof.dr. H. Waalkens		AST, P
Geometry and Topology (23/24)	WMMA018-05	biennial	5	dr. A.V. Kiselev	prof.dr. J. Top		AST, WE
Integrable Systems	WMMA037-05	annual	5	dr. T.F. Görbe	dr. N. Martynchuk		P, AST
Spectral Theory (23/24)	WMMA047-05	biennial	5	dr. M. Seri	prof.dr. H. Waalkens		AST, OE
Geometry and Differential Equations (24/25)	WMMA017-05	biennial	5	tbd in 24/25	tbd in 24/25		WE
General modules							
Mathematics and its Environment	WMMA013-05	annual	5	Vacancy	prof.dr.ir. R.W.C.P. Verstappen		AST, P, R
Student Colloquium	WMMA029-05	annual	5	dr. M. Seri	dr. S. Muller dr. G.F.Y. Bonnet prof. dr. J.G. Peypouquet J. Koellermeier, PhD		P, R
Research Seminar in Mathematics	WMMA030-05	annual	5	dr. O. Lorscheid	dr. G.F.Y. Bonnet dr. S. Muller		P
Research Projects							
Master Research Project	WMMA902-50	annual	50	See list below	See list below		PR, P, R

Mathematical Research Project (Science, Business and Policy)	WMMA903-30	annual	30	See list below	See list below		PR, P, R
<i>Other electives</i>							
Contemporary Statistics with Applications	WMMA015-05	annual	5	prof.dr. M.A. Grzegorzcyk	dr. W.P. Krijnen	x	AST, R
Statistical Genomics (23/24)	WMMA008-05	biennial	5	prof.dr. P. Trapman	prof.dr. M.A. Grzegorzcyk	x	AST, PR, R
Statistical Consulting (24/25)	WMMA024-05	biennial	5	tbd in 24/25	tbd in 24/25		P, R
Introduction to Data Science	WMCS002-05	annual	5	See MSc CS	See MSc CS		AST, WE
Statistical Signal Processing	WMAS011-05	annual	5	see MSc AS	see MSc AS		AST, WE

The modules of the Business and Policy component are

Module	Course code	Offered	ECTS	First examiner	Second examiner (if necessary)	Prac- tical	Assessment type
Introduction Science and Business	WMSE001-10	annual	10	M.R. Berger M.K. de Boer G.J.W. Euverink J.C. Graver I S. Grooters J. Krooneman G.A.H. Laugs A.S. Maqbool M.J. van den Nieuwenhof- Schilstra M. van Rijssel J. Zevenberg			AST, R, WE
Introduction Science and Policy	WMSE002-10	annual	10	M.R. Berger M.K. de Boer G.J.W. Euverink J.C. Graver I S. Grooters J. Krooneman G.A.H. Laugs A.S. Maqbool M.J. van den Nieuwenhof- Schilstra M. van Rijssel J. Zevenberg			AST, R, WE
Work Placement Science, Business and Policy	WMSE902-40	annual	40	M.R. Berger M.K. de Boer G.J.W. Euverink J.C. Graver I	See list below		PR, R

				S. Grooters J. Krooneman G.A.H. Laugs A.S. Maqbool M.J. van den Nieuwenhof- Schilstra M. van Rijssel J. Zevenberg			
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Examiners for Research Project (30 ECTS and 50 ECTS) and Work Placement Science, Business and Policy

dr. G.F.Y. Bonnet
dr. S. Donderwinkel
dr. T.F. Görbe
prof.dr. M.A. Grzegorzczuk
dr. H. Jardon Kojakhmetov
dr. P. Kilicer
dr. A.V. Kiselev
dr. W.P. Krijnen
dr. O. Lorscheid
dr. J.S. Müller
prof.dr. T. Müller
dr. N. Martynchuk
prof. dr. J.G. Peypouquet
prof.dr. C. Salgado
dr. M. Seri
dr. A.E. Sterk
dr. R. Szabó
dr. P. Tibboel
prof.dr. P. Trapman
prof.dr. J. Top
dr. R. van der Veen
prof.dr. E.A. Verbitskiy
prof.dr. H. Waalkens

Examiners of the research project of the master's degree programme in applied mathematics may act as a second examiner for the research project of the master's degree programme in mathematics as well.

On an individual basis the Board of Examiners can allow examiners of other degree programmes to act as examiner for the research project of the master's degree programme in mathematics as well.

6. Relationship between course units and details of the learning outcomes

In this section the relation between the course units and the learning outcomes (generic learning outcomes A1-A9 and variant-specific learning outcomes P1-P4 and M1-M4) is shown. Here the following notation is used:

1 : the course makes a limited contribution to the specified learning outcome

2: the course makes a substantial contribution to the specified learning outcome

Specialization: Probability and Discrete Mathematics																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA039-05	2	1	1			2	2	1		2	2	1	1				
WMMA041-05	1	1	1			1	1		1	2	1	1	1				
WMMA049-05	1	1	1			1	1		1	2	1	1	1				
WMMA061-05	1		1	1	1				1	1	2	2					
WMMA036-05	2		1			1	1		1	2	1	1					
WMMA046-05	2		1			1	1		1	2	1	1					
WMCS027-05	2	1	1	1		1	1			1		1					

<i>Specialization: Number Theory and Algebraic Geometry</i>																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA033-05	2		1			1	1			1			1				
WMMA018-05	2	1				1	1	1		2		2	1				
WMMA038-05	1	1	2			1	1			2		2					
WMMA048-05	1	1	2			1	1			2		2					
WMMA045-05	2	1	1			1	1		1	2		1	1				
WMMA035-05	2	1	1			1	1		1	2		1	1				

<i>Specialization: Analysis and Dynamical Systems</i>																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA032-05	2	1	1			1	1			1	1	1					
WMMA043-05	2	1	1			1	1			1	1	1					
WMMA031-05	1	1	1	1	1	1	1	1		1	1	1	1				
WMMA042-05	1	1	1	1	1	1	1	1		1	1	1	1				
WMMA037-05	2	1	1			1	1			1	1	1					

WMMA047-05	2	1	1			1	1			1	1	1	1				
WMMA017-05	2	1		1		1	1	1	1	2	1		1				

<i>Specialization: Geometry and Topology</i>																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA033-05	2		1			1	1			1			1				
WMMA018-05	2	1				1	1	1		2		2	1				
WMMA037-05	2	1	1			1	1			1	1	1					
WMMA040-05	1	1	2			1	1	2	1	2		1	1				
WMMA017-05	2	1		1		1	1	1	1	2	1		1				
WMMA034-05	2	1	1			1	1		1	2		1	1				
WMMA044-05	2	1	1			1	1		1	2		1	1				

<i>Specialization: Mathematical Physics</i>																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA019-05	2	1		1	1	1	1	1	1	1	1	1	1				
WMMA032-05	2	1	1			1	1			1	1	1					
WMMA043-05	2	1	1			1	1			1	1	1					
WMMA018-05	2	1				1	1	1		2		2	1				
WMMA037-05	2	1	1			1	1			1	1	1					
WMMA047-05	2	1	1			1	1			1	1	1	1				
WMMA017-05	2	1		1		1	1	1	1	2	1		1				

<i>General modules</i>																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA013-05					2	1		2		1			1				1
WMMA029-05			1			1	2	2	2	1	1	1	1				
WMMA030-05			1			1	2	2	2				1				

Research Projects																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA902-50	1	2	2		2	2	2	2	2	2	2	2	2				
WMMA903-30	1	2	2		2	2	2	2	2								1

Other electives																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMMA015-05	2	1				2	1		1	2							
WMMA008-05	2	1		1		1	1			2							
WMMA024-05	1		1	2	1	2	1	2									1
WMCS002-05	1	1	1			1	1	1		2	1	1					
WMAS011-05	1			2		1	1					1					

Track: Science, Business and Policy																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	P1	P2	P3	P4	M1	M2	M3	M4
WMSE001-10				2	2			1						2	2	2	1

WMSE002-10				2	2			1						2	2	2	1
WMSE902-40				2	2		2	2						2	2	2	2