Education and Examination Regulations 2023-2024

Master Mathematics

Radboud Universiteit

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EER 23-24 MA Mathematics [English version]

PART I GENERAL PROVISIONS MASTER

Section 1. General Provisions

Article 1.1 Applicability of these regulations

1. These Education and Examination Regulations (hereinafter EER) apply to the Master's programmes (the degree programme in which the student is enrolled is hereinafter referred to as 'the programme'), including all their components, of the Faculty of Science. These EER outline the applicable procedures, rights and obligations concerning teaching, interim examinations and final examinations.

2. The present regulations apply to all students enrolled in the programme in the 2023-2024 academic year. Students who started the degree programme before 1 September 2016 and have been continuously enrolled in this programme may appeal to the EER that were active at the time of their initial enrolment in the programme.

3. Course components provided by other faculties or institutions are subject to the rules applicable at the faculty or institution in question. Components offered by the Faculty of Science are subject to the regulations described in at least one of the EER of the Faculty of Science at all times.

4. The faculty offers the following 120 EC Master's programmes:
    a. Biology;
    b. Computing Science;
    c. Mathematics;
    d. Medical Biology;
    e. Molecular Sciences
    f. Physics and Astronomy;
    g. Science Education

5. The faculty offers the following 60 EC Master's programmes:
    a. Information Sciences.

6. The degree programmes are offered exclusively as full-time programmes.

7. The programmes are taught in English, The exception to this is the education components of the Science and Education specialisations in the Master's programmes Biology, Mathematics, Medical Biology, Molecular Sciences and Physics and Astronomy and the Master's programme in Science Education, which are provided in Dutch.

Article 1.2 Executive Board Guidelines

1. The Executive Board has laid down the following guidelines with a view to the organisation and coordination of the provisions in these regulations: The guidelines can be found in the Appendix:
    a. Distinction Regulations.
    b. Fraud Regulations

Article 1.3 Definition of terms

1. The terms used in these EER that are also used in the Higher Education and Research Act (*Wet op het hoger onderwijs en wetenschappelijk onderzoek*, hereinafter, 'the Act') will have the same meaning as in the Act.

2. Apart from the terms referred to in paragraph 1, the terms below are understood to have the following meanings:

   a. Degree programme: the Master's programme, as referred to in Article 7.3a, paragraph 1 of the Act;

   b. Component: an educational unit as referred to in Article 7.3, paragraphs 2 and 3 of the Act;

   c. Student: anyone enrolled at Radboud University for participation in a degree programme or in the partial examinations or final examinations of a programme;

   d. Academic year: the period from 1 September in a given year until 31 August of the following year;

   e. Practical: a practical exercise as referred to in Article 7.13, paragraph 2 under D of the Act;

   f. Interim examination: an examination testing the knowledge, understanding or skills of the student in relation to a certain unit of study, as well as the assessment of the results of this examination, which is administered by at least one examiner designated by the Examining Board. For the purpose of these regulations, a partial examination or a resit is also considered an interim examination;

   g. Partial examination: an examination of the knowledge, insight and skills of the student, as well as the assessment of the results of the examination, which, in conjunction with one or more other partial examinations, constitute the interim examinations as referred to under paragraph f. In these regulations, when the term 'examination' is used, this can also be read as 'partial examination', unless explicitly indicated otherwise;

   h. Resit: an opportunity to retake a particular examination as referred to in Article 7.10, paragraph 1 of the Act. In these regulations, when the term examination is used this can also be read as resit, unless explicitly indicated otherwise;

   i. Final examination: an assessment, on the basis of which the Examining Board determines whether all the components pertaining to the Master's programme have been completed successfully. The Examining Board may decide that the final examination also includes an investigation by the Examining Board into the knowledge, insight and skills of the candidate, as well as the assessment of the outcomes of that investigation (in accordance with Article 7.10 WHW);

   j. Final paper: The final paper is an academic aptitude test with respect to the study programme's specific discipline. The programme-specific part of the EER defines what combinations of products and/or assessments are involved in the study programme's final paper. Final papers involve two examiners.

   k. fraud: any behaviour or negligence on the part of the student that, by its nature, is directed toward making it partly or entirely impossible to properly assess the knowledge, insights and skills of the student or of another student.

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l. examining Board: the examining board of a degree programme, established in accordance with Article 7.12 of the Act. Also see the Radboud University Structural Regulations;

m. examiner: the person designated by the Examining Board to administer the interim examinations, in accordance with Article 7.12 of the Act;

n. EC: European Credits, i.e. the study load unit in accordance with the European Credit Transfer System;

o. specialisation: a coherent programme within the Master's programme that has been approved as such by the faculty board;

p. work day: Mondays to Fridays, with the exception of official holidays and any other days designated by Radboud University as collective holidays;

q. awarding of the degree certificate: the formal confirmation that all the final examination requirements have been met;

r. Study guide: the guide containing specific information about one of the Faculty of Science's Master's degree programmes;

s. The University: Radboud University;

t. The faculty: The Faculty of Science;

u. The education institute: the organisational unit responsible for the degree programme;

v. free elective: a freely-selected, academic, assessable component;

w. Rules and regulations: the rules in which the Examination Board explain how it works in accordance with the Education and Examination Regulations.

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PART II GENERAL PART

Section 2. Admission to the degree programme and education

Article 2.1 Admission and admission requirements
1. Decisions regarding admission are made by the education institute on behalf of the dean.
2. The programme-specific part of these EER lists the admission requirements students must meet to be admitted to the degree programme.

Article 2.2 Language requirements
1. Sufficient command of the English language is required to participate in the programme and to sit examinations in English. This requirement is met if the student:
    a. comes from one of the following countries: Australia, Canada (with the exception of Quebec), Ireland, New Zealand, Singapore, the United Kingdom, the United States or South Africa; or
    b. is in possession of a pre-university education (VWO) diploma; or
    c. is in possession of a pre-university education diploma obtained at an English-language institution in the Netherlands or elsewhere; or
    d. has a pre-university education diploma obtained at a German secondary education institution, with English as Grundkurs/Hauptfach; or
    e. has a Bachelor's diploma from a university of applied sciences (HBO); or
    f. has a Bachelor's diploma from a Dutch university; or
    g. meets the requirements in the opinion of the programme; or
    h. has passed one of the following assessments:
        i. the TOEFL with a score of 575 or higher for the paper version;
        ii. the TOEFL with a score of 90 or higher for the Internet version with none of the sub-scores below 20;
        iii. the IELTS with a score of 6.5 or higher, where none of the sub-scores are below 6.0;
        iv. iv. the Cambridge CAE or CPE with a score of C or higher.
2. Sufficient command of Dutch is required to participate in the programme and to sit examinations in Dutch. Non-Dutch students have met the language requirement for sufficient proficiency in Dutch if they have passed the state examination of Dutch as a second language, level 2. In certain cases, the education institute may assess whether a student is sufficiently proficient in Dutch.

Section 3. Structure and design

Article 3.1 Final examination, degree and distinctions
1. The Master's programme is concluded with the Master's exam.

2. Students who pass the study programme's Master's exam will be awarded a Master of Science degree.
3. The degree referred to in paragraph 2 is awarded exclusively if the student has earned at least half of the EC for their degree programme at this University.
4. The Examining Board can award distinctions to students who have successfully passed the degree programme examination. The rules for awarding distinctions can be found in the annex in the Distinction Regulations.

Article 3.2 General learning outcomes

The degree programme has the following learning outcomes for students:

1. Acquire knowledge, skills and insights in the relevant field of study;
2. Develop academic competences;
3. Prepare for further study or a future career;
4. Strengthen qualifications in the area of independent academic research.

Article 3.3 Curriculum

1. The programme comprises the total of the components as described in the programme-specific part of these regulations and is aimed at the realisation of well-defined objectives regarding the knowledge, understanding and skills that students are expected to possess upon successful completion.
2. For each section, the lecturer should make a course guide available prior to the course, which includes a description of the course, assessments with weighting factors and deadlines of (partial) exams. Contrary to the above provisions, the course description, weighting factors and course deadlines completed in periods 3 and 4 may still be changed until the start of period 2 with the permission of the programme coordinator. The information in the study guide takes precedence.
3. Some modes of instruction have attendance/participation requirements. If this is the case, this will be mentioned in the course description of the study guide. Regular lectures and seminars do not have attendance/participation requirements.
4. The programme has research specialisations and societal specialisations. The specialisations are described in the programme-specific part.
5. Each degree programme includes a component that is philosophical in nature with a minimum study load of 3 EC, a free elective space of 6 EC and a component to aid reflection on study performance, study planning, and professional orientation with a study load of 1 or 2 EC.
6. The electives cannot have substantial overlap in content with other components in the nominal space of the study programme. It is not possible to receive an exemption for the elective component based on a Bachelor's course.
7. The composition of the Master's programme compiled by the student must be presented to the Examining Board for approval no later than three months before the expected examination date. The Examination Board will decide whether to grant approval within a month of receiving the submitted programme.
8. Students can only participate in components provided by the Radboud Teachers Academy of Education after the disciplinary internship has been completed. Students can only

participate in the Science, Management and Innovation final research project after the student has passed the thematic components and NWI-FMT019 Methods in Societal Research: Science, Management & Innovation. A student can only participate in the Science in Society research project after 12 EC has been obtained from the SiS curriculum.

9. Students can add components to the examination programme. If these components mean that the student exceeds the total study load of 120 EC of the Master's programme, these components are always regarded as extracurricular. This is not an issue if courses have to be split for this purpose. Extra-curricular components do not count towards the determination of the distinction.

10. If a student has a choice between components within the curriculum and the student has passed more than one of these components, then the student can decide which components will count toward their distinction if one or more of the components are extra-curricular.

11. Extracurricular components are admissible if, in the opinion of the Examining Board, the course is testable at an academic level.

Article 3.4 Types of interim examination

1. Each component of the degree programme is concluded by an interim examination. Interim examinations may comprise more than one modular partial examination and may consist of the following assessment forms:
   a. Written test and/or;
   b. Oral test and/or;
   c. Presentation and/or;
   d. Skill test and/or;
   e. The creation of a discipline-specific product and/or text.

2. Prior to the commencement of the academic year, information will be provided in the prospectus on each individual component regarding how the interim examinations will be administered and how their results will be determined, taking the weighting of any partial exams into account. At the request of the student or the examiner, the Examining Board may allow an exam to be taken in a form other than preciously announced, if this is not to the detriment of the student.

3. In cases where an interim examination has admission requirements, the admission requirements will be published in the prospectus before the start of the academic year, see Article 3.3, paragraph 2. This requires permission from the programme coordinator. Contrary to the above provisions, the admission requirements for the courses completed in the fourth period may still be changed up until the start of the second period, with permission from the programme coordinator.

4. There are no admission requirements for interim examinations; if students are enrolled in a component, they are admitted to all sub-components, including the interim examination.

5. Students with functional impairments are given the opportunity to take exams in a manner appropriately suited to their impairment. The Examining Board shall, if necessary, seek expert advice and counsel prior to reaching its decision. If the students in question require certain facilities for their interim examinations or resits, they must request these from the

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Education and Examination Administration of the faculty no later than two weeks before the interim examination or resit.

6. During oral examinations, no more than one person is tested at a time, unless decided otherwise by the Examination Board.

7. Oral interim examinations are not public, unless the Examining Board has deemed otherwise in exceptional cases. Oral exams are recorded or a second examiner or designated observer will be present.

Article 3.5 Exemptions

1. At the request of the student and having heard the examiner involved, the Examination Board may exempt a student, either partially or fully, from sitting for an interim examination if the student:
   a. Has completed a course in a relevant subject at a university or institute of higher vocational education (HBO);
   b. Demonstrates that they have adequate knowledge and skills regarding the component in question as a result of relevant work experience or professional experience.

2. If the degree programme allows group exemptions, then these are included in the programme-specific part of these regulations.

3. Only one grade for each course may be registered for a single degree programme. If a course is also part of another examination programme, this course will be listed on the qualification as an exemption on the other diploma.

4. Students who were first enrolled on or after 1 September 2017 can never have more exemptions than a quarter of the total study load of the programme expressed in EC, as stated in paragraph 1.

5. All results for a degree programme achieved before the date of the first enrolment are stated as exemptions on the degree programme's diploma. These exemptions do not count towards the ECs as stated in clause 4 if the courses are only included in a one examination programme.

6. Exemptions as referred to in paragraphs 1 and 2 cannot be granted for final examination assignments.

Article 3.6 Term of validity for successfully completed interim examinations

1. The term of validity of successfully completed interim examinations is unlimited.

2. Passed partial exams are valid indefinitely, unless the lecturer specifies otherwise. The interim examinations are valid at least until the end of the academic year.

3. A successfully passed examination may be taken again. If a student resits an exam, the last result obtained is always valid for the study programme in which the exam is resit.

Article 3.7 Elective programmes

The programme Examining Board shall decide on a request for authorisation to follow a free elective as referred to in Article 7.3d of the WHW. The Examination Board will verify whether the programme fits within the domain of the degree programme under the authority of the Examination Board,

whether it is sufficiently cohesive, and whether the level is adequate in the context of the programme's exit qualifications. The programme-specific part of these EER may contain further criteria for the order in which components may be taken and the related interim examinations.

Section 4. Examinations

Article 4.1 Frequency of interim examinations

1. Students are given the opportunity to take the examinations at least twice per academic year per interim examination.
2. Contrary to the provisions of paragraph 1, a degree programme coordinator may decide to only offer one opportunity for an interim examination or partial examination. If only one opportunity is given to take an interim examination or partial examination, this is stated in the programme study guide before the start of the academic year.
3. Notwithstanding the provisions in the first paragraph, there will be at least one opportunity in the following year to take an interim examination for a course that was taught for the final time in a particular academic year.
4. If a certain component is not given in a particular academic year, the opportunity to take the corresponding examination will be offered once in that academic year, as long as the interim examination is administered in written or oral form.

Article 4.2 Registration for course examinations

1. Students who register through Osiris for a component are automatically registered for the first interim examination opportunity in the relevant academic year. This does not apply to students whose enrolment in the degree programme has not yet been completed.
2. Students can register for an examination right up until 11:59 pm on the day prior to a period of five working days before the date of the examination. Registration is no longer possible after this date, unless the head of Education Centre decides otherwise in special cases on behalf of the dean.

Article 4.3 Confirmation of examination results

1. The result of an interim examination is determined by an examiner in the form of a grade on a scale from 1 to 10 (with 10 being the highest possible grade), consisting exclusively of whole numbers or half numbers. However, a grade of 5.5 is never given. When rounding off between 5 and 6, the rule is that a grade lower than 5.5 is rounded down to a five (5), which is an insufficient grade, meaning the educational component has not been successfully completed; a 5.5 and higher is rounded up to a six (6), meaning that the educational component has been successfully completed. In addition to results that take the form of a grade, an assessment of 'completed' ('voldaan' - V), 'not completed' ('niet voldaan' - NV), 'pass' ('voldoende' - VLD), 'fail' ('onvoldoende' - OV), 'good' ('goed' - G) and 'very good' ('zeer goed' - ZG) may also be awarded.
2. Notwithstanding the provisions of paragraph 1, partial examinations may also be graded with one decimal point on a 1 to 10 point scale. Rounding off of grades is only done for the final grade of the component.

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Article 4.4 Publication of results

1. The examiner shall determine the result of the final project within 15 working days after the presentation of the final project has taken place and after the final project has been submitted, using the method specified in the study guide.
2. The examiner shall determine the result of an interim examination within 15 working days of the date the examination was administered. Here, the precondition applies that there must be at least ten working days between the date of the publication of the result in Osiris and the date of the resit.
3. Contrary to the provisions in paragraph 2, the examiner shall determine the result of an interim examination in the fourth period no later than nine days before the scheduled date of the corresponding resit. The lecturer always has at least five working days after the written examination to determine the result.
4. Contrary to the provisions set out in paragraph 2, the examiner shall determine the result of an oral examination within two working days of the date it was administered.
5. In special cases, the Examination Board may extend the term in which the result must be determined as referred to in paragraph 2 and 3 by a maximum of 10 working days. This is not possible for interim examinations in the fourth period. The lecturer will inform students of this extension.
6. In this statement of the result of an interim examination, the student is also informed of their right to inspection, referred to in Article 4.5 as well as the right to appeal to the Examination Appeals Board.
7. Students may submit an appeal of a decision by the Examination Board to the Examination Appeals Board within six weeks.

Article 4.5 Right of inspection and explanation

1. Students may request access to review and inspect all graded work within at least 30 working days following publication of a written interim examination result. For the results of interim examinations with 'open' questions, at their request, the student shall be granted a copy of their graded work at cost.
2. During period referred to in paragraph 1 of this Article, any student who has taken an interim examination may review the questions and assignments of the interim examination in question, as well as the standards on which the result was based.
3. Students must be offered at least one opportunity to inspect or have their examinations explained, as referred to in paragraphs 1 and 2. If the student demonstrates that they are or were unable to attend an inspection, they may request the Examination Board to allow them another opportunity to inspect the examination, within the period referred to in paragraph 1 if possible. In all cases, the inspection must take place at least five working days before the resit of an interim examination. For examinations in the fourth period, students may view their work until one working day before the resit.
4. The examiner shall retain all written interim examinations and related papers (assignments or otherwise) that count towards the final result for a period of two years following the date when the examination was administered. Master's programme reports and theses

must remain available for visitations, accreditations and inspections, and shall be kept for seven years.

Article 4.6 Confirmation of examination results

1. Students are given the opportunity to take the final examination after they have provided sufficient proof of passing the components leading up to the final examination.
2. Examinations are scheduled each month.
3. The Examining Board will determine the result of the final examination, as well as the rules in relation to the manner in which the result of the examination is determined. The result of the examination is determined by the Examining Board within five weeks following the student's request. If the examination took place in July, the results will be determined no later than 31 August. Where needed in relation to entry requirements for a subsequent programme or the acceptance of a job, a statement can be released indicating that the student has met the requirements of the examination within five days. This is only possible if the student has met the criteria specified in clause 1.
4. Prior to determining the result of the final examination, the Examination Board may evaluate and assess the student's knowledge with respect to one or more components or aspects of the programme, if and to the degree to which the results of the related interim examinations justify this.

Article 4.7 Awarding distinctions

The guidelines concerning distinctions can be found in the Appendix of the Distinction Regulations.

Section 5. Study performance, guidance and evaluation of education

Article 5.1 Study performance and support

1. The faculty dean is responsible for recording student results in such a way that, upon request, the Examination Board can respond by providing the student with an overview of the progress of the study programme within a reasonable time frame.
2. The dean is responsible for providing adequate student counselling.

Article 5.2 Method of evaluation of education

In compliance with the quality assurance system of the university as described in the Handboek Kwaliteitszorg Onderwijs Radboud Universiteit (Radboud University Quality Assurance Manual), the dean shall ensure that the education of the degree programmes is evaluated systematically.

PART III   PROGRAMME-SPECIFIC PART

Section 6. Admission to the study programme and education

Article 6.1 Admission requirements
The following students are admissible to the programme:
1. Students who have successfully passed the final examination of the Bachelor's programme in Mathematics at Radboud University.
2. Students who have successfully passed the final examination of the Bachelor's programme in (Technical) Mathematics at another Dutch university.
3. Students who have successfully completed the final examination of the Bachelor's programme in Physics and Astronomy at Radboud University with the following Mathematics courses: NWI-WP029 Inleiding Wiskunde, NWI-WP030 Groepentheorie, NWI-NP028 Lineaire Algebra B, NWI-WP001B Analyse 1, NWI-WB001B Analyse 2, NWI-WB012B Ringen en Lichamen, NWI-WB003F Gewone Differentiaalvergelijkingen + Numerieke Methoden/NWI-WB104 Gewone Differentiaalvergelijkingen, and NWI-WB027B Topologie.
4. Students who are in possession of a certificate that is at least equivalent to the qualifications referred to in paragraphs 1, 2 and 3.
5. Students who meet the requirements mentioned in paragraph 4 must provide proof of sufficient proficiency in English, as described in Article 2.2.

Section 7. Structure and design

Article 7.1 Programme-specific learning outcomes
Graduates of the Master's Programme in Mathematics will have achieved the following qualifications:
1. Graduates have acquired knowledge, skills and insights in the area of mathematics that enable them to independently carry out their profession and qualify for advanced programmes as researchers and designers.
2. Graduates have acquired specialist knowledge and insight in at least one sub-specialisation of mathematics.
3. Additionally, graduates have acquired specialist knowledge of another sub-specialisation of mathematics, or of a mathematics-related topic outside the field of mathematics.
4. Graduates are able to acquire independent insight into new developments in their field.
5. Graduates have learned to independently solve complicated problems and formulate solutions, while simultaneously critically assessing established academic insights.
6. Graduates possess adequate computer and computing skills.
7. Graduates can acquire new knowledge in the area of mathematics and integrate this into their existing knowledge. In doing so, they possess the learning skill to orientate themselves at the level of a specialist in a sub-specialisation of mathematics outside their chosen specialisation.
8. Graduates are able to communicate with their peers on academic knowledge, at both a basic and a specialised level. Graduates are also able to hold oral presentations and write clear

articles on research that they have conducted, also for a general non-specialist audience. Graduates can prepare both oral and written reports and can debate scientific topics.

9. Graduates possess sufficient knowledge and insight into the role of mathematics in society to enable them to perform satisfactorily in their future positions and to reflect on social and ethical problems.

10. Graduates have demonstrated, by completing a thesis, the ability to independently develop or apply mathematics at a sufficient standard or to apply it in context.

Specific qualifications that are gained through the different specialisations:

Research specialisation "Mathematics" (as described in Article 7.2.1):
Graduates:
1. have a broad and in-depth overview of the main theme of the Master's specialisation, and fundamental knowledge of capita selecta in connection to the subject of the Master's thesis.
2. are able to keep up to date independently on developments in Mathematics by a review of literature.
3. are able to formulate new research questions and hypotheses in the field of Mathematics, and to select suitable techniques and research methods to answer these questions.

Specialisation 'Science, Management and Innovation' (as described in Article 7.2.2):
Graduates:
1. have knowledge of the Sustainable Development Goals (SDGs) from their own discipline and societal context
2. can set up and carry out interdisciplinary research independently
3. can work towards sustainable and innovative solutions based on research
4. can make proposals understandable to relevant stakeholders (academic and non-academic)
5. can create support for the achievement of the SDGs

Specialisation 'Science in Society' (as described in Article 7.2.3):
Graduates are:
1. Capable of analysing the role of scientific expertise in societally relevant issues;
2. Capable of designing and conducting independent, methodologically sound research about the interface of science and society, and contributing to academic research;
3. Capable of understanding and implementing public and stakeholder engagement in research and innovation;
4. Capable of analysing, improving and evaluating interdisciplinary collaborations with multiple stakeholders, integrating different perceptions, interests and types of knowledge (experiential, professional and scientific);
5. Capable of substantiating and communicating the relevance of their scientific discipline in society.

Specialisation 'Science and Education' (as described in Article 7.2.4):

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	Knowledge and insight	Skills		Attitude	
	1. Knowledge and insight	**2. Application of knowledge and insight**	**4. Communication**	**3. Forming judgements**	**5. Learning skills**
A. (Development of) Scientific Competences *2.4, 2.7-2.9, 2.11, 2.13**	Knows and has an understanding of national and international developments in science and its relation to the school subject. This refers to: - **[the scientific discipline]**** - **[(discipline) didactics]** Is familiar with relevant educational and learning theories.	Can carry out scientific research that, in a relevant way, includes elements from the field of: - **[scienctific discipline]** - **[(discipline) didactics]** combined.	Can report on research in an academically responsible manner. In any case, this concerns research that relevantly includes elements from the field of: - **[scienctific discipline]** - **[(discipline) didactics]** combined.	Can make judgements about the quality of research in these areas from **[scientific discipline]** and **[(discipline) didactic knowledge]** and insights.	Can reflect on own learning from academic education and learning theories and can independently keep pace with national and international developments in academia.
B. (Development of) Didactics Competences *2.4**	Has basic academic knowledge of subject-specific and general didactic insights about teaching and **[the school subject]**.	Can create, implement and systematically evaluate educational designs (including by designing tests). In doing so, they are able to establish a relationship between (course) didactic and course content concepts, pupils' subject-specific thinking at different levels and problems from teaching practice in the course subject.	Communicates clearly with (individual) pupils, colleagues and relevant third parties (e.g. parents), with a focus on cooperation, responsibility and differentiated action and improving the social climate.	Can make judgements about specific problems in [the school subject] and infer appropriate action. Can prioritise developmental and behavioural problems independently, and act appropriately after consulting relevant third parties.	Devotes attention to discipline-specific learning of individual and unique students, focusing on developing inspiring education.
B. (Development of) Pedagogic Competences *2.14, 2.16, 2.18**	Has basic academic knowledge about the development of, and communication with, students in the classroom, the conditions for a powerful learning environment, and how to use them to create an effective working environment.				
C. (Development of) Academic Professional Competencies	Has basic knowledge of standards and requirements related to relevant professional sectors, including at least **[discipline-related professional sectors]** and the professional educational sector.	Can responsibly translate and apply academic knowledge and insights for the benefit of professional practice, including **[discipline-related professional sectors]** and	Can contribute in a constructive and clear manner to relevant collaborations, including: - the academic, public and societal debate - professional groups in **[discipline-related	Can take an academically argued position in relevant collaborations, including: - the academic, public and societal debate - professional groups in **[discipline-related professional sectors]** and the educational sector	Develops a distinct identity in the context of the academic profession. Can interpret own knowledge and actions and the actions and feedback of colleagues, and use them to guide their own professional development.

		educational professional practice. More specifically, can apply academic knowledge and insights for the benefit of school and policy development, subject development and teacher development (both personal development and that of colleagues). Can think and act creatively in problem-solving ways, using digital competences.	professional sectors] and the educational sector - teams at school.	- teams at school. Can critically consider and adjust own actions, using basic knowledge of standards and requirements related to relevant professional sectors.	

* Italicised numbers refer to the relevant paragraph in the *Besluit Bekwaamheidseisen Onderwijspersoneel* (Decree on Proficiency Requirements for Teaching Staff) (16 March 2017).

** Text in square brackets refers to components that are completed in a course-specific way, depending on the chosen specialisation

Article 7.2 Composition of the programme

Subject to the provisions in the general part of these EER, the student chooses one of the following specialisations of the study programme:

1. Mathematics
2. Science, Management and Innovation
3. Science in Society
4. Science and Education

7.2.1 The Master's programme in Mathematics consists of the following components:

1. Track (66 EC)

A choice needs to be made from one of the following tracks. The components provided by the Mastermath collaboration can be found on Mastermath's website (https://elo.mastermath.nl/).

a. Track: Pure Mathematics

		Course	Course name	EC
Mandatory elective (minimum 40 EC):	1	NWI-WM150B	Category Theory and Homological Algebra, *or*	8
		NWI-WM304B	Sheaves and Geometry *or*	8
		NWI-WM270	Calculus of Variations (Mastermath) *or*	8
		NWI-WM144B	Calculus of Variations	8
	2	NWI-WM200	Differential Geometry (Mastermath) *or*	8
		NWI-WM214	Algebraic Geometry 1 (Mastermath)	8
	3	NWI-WM201	Lie Groups (Mastermath) *or*	8
		NWI-WM202	Lie Algebras (Mastermath)	8
	4	NWI-WM094D	Algebraic Topology 1, *or*	8
		NWI-WM203	Algebraic Topology 1 (Mastermath) *or*	8
		NWI-WM072D	Complexity Theory *or*	8
		NWI-WM072C	Complexity Theory (Mastermath)	8
	5	NWI-WM123B	Riemann Surfaces (Mastermath) *or*	8
		NWI-WM240	Elliptic Curves (Mastermath)	8
	6	NWI-WM205	Operator Algebras (Mastermath) *or*	8
		NWI-WM120D	Computability Theory *or*	8
		NWI-WM223	Computability Theory (Mastermath)	8
	7	NWI-WM206	Algebraic Number Theory (Mastermath) *or*	8
		NWI-WM139B	Analytic Methods in Number Theory	8
To be completed with mathematics Master's courses up to at least 54 EC				
Then completed with Master's courses up to 66 EC (max 12 EC)				

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b. Track: Synergy Track Mathematics of Computer Science

		Course	Course name	EC
mandatory (8 EC):		NWI-WM069D	Computer Algebra	8
mandatory elective (minimum 12 EC):		NWI-IMC010	Type Theory and Coq	6
		NWI-IMC011	Semantics and Domain Theory	6
		NWI-IMC036	Category Theory and Coalgebra	6
		NWI-WM158B	Experimental Mathematics	8
		NWI-IMC009	Automated Reasoning	6
		NWI-IMC057	MFoCS Seminar	6
mandatory elective (minimum 16 EC):	1	NWI-WM150B	Category Theory and Homological Algebra, *or*	8
		NWI-WM304B	Sheaves and Geometry *or*	8
		NWI-WM270	Calculus of Variations (Mastermath) *or*	8
		NWI-WM144B	Calculus of Variations	8
	2	NWI-WM200	Differential Geometry (Mastermath) *or*	8
		NWI-WM214	Algebraic Geometry 1 (Mastermath)	8
	3	NWI-WM201	Lie Groups (Mastermath) *or*	8
		NWI-WM202	Lie Algebras (Mastermath)	8
	4	NWI-WM094D	Algebraic Topology 1, *or*	8
		NWI-WM203	Algebraic Topology 1 (Mastermath) *or*	8
		NWI-WM072D	Complexity Theory *or*	8
		NWI-WM072C	Complexity Theory (Mastermath)	8
	5	NWI-WM123B	Riemann Surfaces (Mastermath) *or*	8
		NWI-WM240	Elliptic Curves (Mastermath)	8
	6	NWI-WM205	Operator Algebras (Mastermath) *or*	8
		NWI-WM120D	Computability Theory *or*	8
		NWI-WM223	Computability Theory (Mastermath)	8
	7	NWI-WM206	Algebraic Number Theory (Mastermath) *or*	8
		NWI-WM139B	Analytic Methods in Number Theory	8
To be completed with mathematics Master's courses up to at least 54 EC				
Then completed with Master's courses up to 66 EC (max 12 EC)				

c. Track: Applied Mathematics

		Course	Course name	EC
Mandatory elective (minimum 40 EC):	1	NWI-WM144B	Calculus of Variations *or*	8
		NWI-WM270	Calculus of Variations (Mastermath) *or*	8
		NWI-WM213	Measure Theoretic Probability (MM) *or*	8
		NWI-WM265	Numerical Linear Algebra (Mastermath)	8
	2	NWI-WM246B	Optimal Transport *or*	8
		NWI-WM246C	Optimal Transport (Mastermath)	8
	3	NWI-WM126B	Data Science with Apps in Medicine and Biology *or*	8
		NWI-WM098C	Regression Analysis	8
	4	NWI-WM224	Mathematical Biology (Mastermath) *or*	8
		NWI-WM247	Asymptotic Statistics (Mastermath) *or*	8
		NWI-WM303B	Finite Element Methods	8
	5	NWI-WM216	Forensic Probability and Statistics (MM) *or*	8
		NWI-WM161B	Monte Carlo Methods	8
	6	NWI-WM152B	Martingales and Large Deviations *or*	8
		NWI-WM305	Num Bifurcation An. Large-scale Sys (MM)	8
	7	NWI-WM153B	Nonlinear Wave Equations *or*	8

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		Course	Course name	EC
		NWI-WM151B	Stochastic Simulation *or*	8
		NWI-WM204	PDE (Mastermath)	8

To be completed with mathematics Master's courses up to at least 54 EC

Then completed with Master's courses up to 66 EC (max 12 EC)

d. Track: Mathematics of Data Science Synergy track

		Course	Course name	EC
mandatory (8 EC):		NWI-WM098C	Regression Analysis	8
mandatory elective (minimum 12 EC):		NWI-WM222	Machine Learning Theory (Mastermath)	8
		NWI-IMC030	Machine Learning in Practice	6
		NWI-NM048D	CDS: Machine Learning	3
		NWI-NM047D	Computational Neuroscience	3
		NWI-NM127	Modelling of Real-world Complex Systems	6
mandatory elective (minimum 16 EC):	1	NWI-WM144B	Calculus of Variations *or*	8
		NWI-WM270	Calculus of Variations (Mastermath) *or*	8
		NWI-WM213	Measure Theoretic Probability (MM) *or*	8
		NWI-WM265	Numerical Linear Algebra (Mastermath)	8
	2	NWI-WM246B	Optimal Transport *or*	8
		NWI-WM246C	Optimal Transport (Mastermath)	8
	3	NWI-WM126B	Data Science with Applications in Medicine and Biology *or*	8
		NWI-WM098C	Regression Analysis	8
	4	NWI-WM224	Mathematical Biology (Mastermath) *or*	8
		NWI-WM247	Asymptotic Statistics (Mastermath) *or*	8
		NWI-WM303B	Finite Element Methods	8
	5	NWI-WM216	Forensic Probability and Statistics (MM) *or*	8
		NWI-WM161B	Monte Carlo Methods	8
	6	NWI-WM152B	Martingales and Large Deviations *or*	8
		NWI-WM305	Num Bifurcation An. Large-scale Sys (MM)	8
	7	NWI-WM153B	Nonlinear Wave Equations *or*	8
		NWI-WM151B	Stochastic Simulation *or*	8
		NWI-WM204	PDE (Mastermath)	8

To be completed with mathematics Master's courses to a minimum of 54 EC

Then supplement with Master's courses up to 66 EC (maximum 12 EC)

e. Track: Mathematical Physics

		Course	Course name	EC
Mandatory elective (minimum 40 EC):	1	NWI-WM200	Differential Geometry (Mastermath) *or*	8
		NWI-WM263	Symplectic Geometry (Mastermath)	8
	2	NWI-WM068D	Noncommutative Geometry *or*	8
		NWI-WM210	Poisson Geometry (Mastermath)	8
	3	NWI-WM201	Lie Groups (Mastermath) *or*	8
		NWI-WM202	Lie Algebras (Mastermath)	8
	4	NWI-WM270	Calculus of Variations (Mastermath) *or*	8
		NWI-WM144B	Calculus of Variations *or*	8
		NWI-WM204	PDE (Mastermath)	8
	5	NWI-WM153B	Nonlinear Wave Equations *or*	8
		NWI-WM159B	Singularities and Black Holes	8
	6	NWI-WM218	Functional Analysis (Mastermath) *or*	8

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		Course	Course name	EC
		NWI-WM205	Operator Algebras (Mastermath)	8
	7	NWI-WM233	Quantum Computing (Mastermath) *or*	8
		NWI-WM235	Quantum Information Theory (Mastermath)	8
To be completed with mathematics Master's courses up to at least 54 EC				
Then completed with Master's courses up to 66 EC (max 12 EC)				

f. Track: Synergy Track Gravity+

		Course	Course name	EC
mandatory elective (minimum 12 EC):		NWI-NM107	General Relativity	6
		NWI-NM024C	Foundations & Frontiers of GW Astrophysics	6
		NWI-NM114	Quantum Gravity	6
		NWI-WM159B	Singularities and Black Holes	8
		NWI-WM153B	Nonlinear Wave Equations	8
		NWI-NM124	Gravity+ Club	3
mandatory elective (minimum 24 EC):	1	NWI-WM200	Differential Geometry (Mastermath) *or*	8
		NWI-WM263	Symplectic Geometry (Mastermath)	8
	2	NWI-WM068D	Noncommutative Geometry *or*	8
		NWI-WM210	Poisson Geometry (Mastermath)	8
	3	NWI-WM201	Lie Groups (Mastermath) *or*	8
		NWI-WM202	Lie Algebras (Mastermath)	8
	4	NWI-WM270	Calculus of Variations (Mastermath) *or*	8
		NWI-WM144B	Calculus of Variations *or*	8
		NWI-WM204	PDE (Mastermath)	8
	5	NWI-WM153B	Nonlinear Wave Equations *or*	8
		NWI-WM159B	Singularities and Black Holes	8
	6	NWI-WM218	Functional Analysis (Mastermath) *or*	8
		NWI-WM205	Operator Algebras (Mastermath)	8
	7	NWI-WM233	Quantum Computing (Mastermath) *or*	8
		NWI-WM235	Quantum Information Theory (Mastermath)	8
To be completed with mathematics Master's courses up to at least 54 EC				
Then completed with Master's courses up to 66 EC (max 12 EC)				

2. Mandatory components (5 EC)

Course code	Course name	EC
NWI-WM115C	Master Seminar*	3
NWI-WM301	Professional Preparation for Math	2

3. Philosophical component (3 EC)

The student must follow at least 3 EC courses of a philosophical nature at Master's level. Courses from the table below have been pre-approved.

NB: Not all courses are offered annually, and some are subject to enrolment restrictions.

Course code	Course name	EC
NWI-FFIL212	Philosophy of Water Management	3
NWI-FFIL215	Upgrading the Human?	3
NWI-FFIL216	Imagining the Anthropocene	3

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NWI-FFIL217	Science and Arts	3
NWI-FFIL218	Science and Values	3
NWI-FFIL219	Philosophy of Neuroscience	3
NWI-FFIL220	Philosophy of Evidence and Expertise	3
NWI-FFIL302	Philosophy and Ethics in Microbiology	3
NWI-FFIL202A	Evolution and the Mind	3
NWI-FFIL203B	Bio-ethics for Life Scientists	3
NWI-FFIL209B	Environmental Ethics	3
NWI-FFIL211B	Physics and Philosophy	3
NWI-EDU-WI001	History and Philosophy of Mathematics	6
NWI-WM256	History and Philosophy of Mathematics (Mastermath)	8
NWI-FFIL220	Philosophy of Evidence and Expertise	3
NWI-FFIL221	Compete or Collaborate? - An Introduction to Disciplines and Interdisciplinarity	3

4. Free electives (6 EC)

5. Final paper (40 EC)
NWI-WM052C Master Thesis Project Mathematics (40 EC)

7.2.2 Science, Management and Innovation

The Master's programme in Mathematics with the specialisation Science, Management and Innovation consists of the following components:

1. Track (24 EC)
A choice needs to be made from one of the tracks as named in Article 7.2.1 point 1a, c or e. A minimum of 24 EC must be obtained from the listed courses.

2. Mathematical Electives (22 EC)
The students must take 22 EC of mathematics courses at the Master's level. This course package must be presented to the Examining Board for approval.

3. Mandatory components (5 EC)
The student must take 5 EC of mandatory components as named in Article 7.2.1 point 2.

4. Philosophical component (3 EC)
The student must follow at least 3 EC courses of a philosophical nature at Master's level, as indicated in Article 7.2.1 point 3.

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5. Free electives (9 EC)

Students can use the free elective space to expand the Science, Management and Innovation final research project by 3 EC.

6. Specialisation space (57 EC)

a. Mandatory courses (15 EC)

Course code	Course name	EC
NWI-FMT003E	Sustainable Innovation Management	6
NWI-FMT030	Reaching the Sustainable Development Goals	6
NWI-FMT019	Methods in Societal Research: Science, Management & Innovation	3

b. Theme courses (15 EC)

Choice of one of the themes:

Climate and Energy

Course code	Course name	EC
NWI-FMT022	Energy and Climate	6
NWI-FMT026	Energy Modelling	3
NWI-FMT032	Environmental Life Cycle Assessment	6

Health

Course code	Course name	EC
NWI-FMT023	The Future of Health	6
NWI-FMT029	How Health Systems Work	6
	Free electives	3

Green Industries & IT

Course code	Course name	EC
NWI-FMT022	Energy and Climate	6
NWI-SM299	Pattern Recognition in the Natural Science	3
NWI-FMT032	Environmental Life Cycle Assessment	6

Biodiversity

Course code	Course name	EC
NWI-BM038A	Ecological and Environmental Concepts	3
NWI-BM075	Biodiversity Assessment	3
NWI-BM033F	Nature in a Crowded Country	3
NWI-FMT032	Environmental Life Cycle Assessment	6

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c. Science, Management and Innovation Final research project (27 EC) (NWI-FMT033)

The SMI research project may, in consultation with the SMI coordinator or a lecturer from the SMI specialisation, be completed both internally (within RU/Radboudumc) or externally (government, businesses, consulting firms, NGOs, etc.), at home or abroad. In the first month, the student will write a research plan that must be approved by both the external and first supervisor, as well as the second reader. Of the latter two, at least one is from the Mathematics department. The assessment of the thesis is based on the criteria described in the manual "Doing a research project: A guide for students of the Science, Management & Innovation Master's specialisation".

7.2.3 Science in Society

The Master's programme in Mathematics with the specialisation Science in Society consists of the following components:

1. Track (24 EC)
A choice needs to be made from one of the tracks as named in Article 7.2.1 point 1a, c or e. A minimum of 24 EC must be obtained from the listed courses.

2. Mathematical Electives (22 EC)
The students must take 22 EC of mathematics courses at the Master's level. This course package must be presented to the Examining Board for approval.

3. Mandatory components (5 EC)
The student must take 5 EC of mandatory components as named in Article 7.2.1 point 2.

4. Philosophical component (3 EC)
The student must follow at least 3 EC courses of a philosophical nature at Master's level, as indicated in Article 7.2.1 point 3. A course chosen as a course for the philosophical component may not be chosen as a philosophy elective (7.2.3.6a).

5. Free electives (9 EC)

6. Specialisation space (57 EC)
The Master's specialisation Science in Society consists of two partially corresponding 'tracks': Science and Societal Interaction & Philosophies and Worldviews.

    a.   **Trackspecific courses (27 ec)**

    Science and Societal Interaction:

Course code	Course name	EC
NWI-FFIL218	Science and Values	3
NWI-FC0045	Science and Public Participation	6
NWI-FC0010D	Framing Knowledge	6
NWI-FC0043B	Science and Public Policy	3
NWI-FC0044C	Methods of Societal Research: Science in Society	6

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Limited choice	Social-science elective	3

A social-science elective (3 EC) must be submitted to the SiS coordinator for approval.

Philosophies and Worldviews:

Course code	Course name	EC
NWI- FFIL218	Science and Values	3
NWI-FFIL220	Philosophy of Evidence and Expertise	3
NWI-FC0010D	Framing Knowledge	6
NWI-FC0044C	Methods of Societal Research: Science in Society	6
Limited choice	Philosophy electives	9

Students can choose from the following courses as philosophy electives (9 EC):

Q1:
- NWI-FFIL216 Imagining the Anthropocene 3
- NWI-FFIL211B Physics and Philosophy 3
- NWI-FFIL209B Environmental Ethics 3

Q2:
- NWI-FFIL212 Philosophy of Water Management 3
- NWI-IMI003 Philosophy and Ethics for Computing and Information Science 3
- NWI-FFIL215 Upgrading the Human 3

A course chosen as a philosophy elective may not be chosen as a course for the philosophical component (7.2.3.4).

b. Science in Society internship and report (30 EC) (NWI-SISSTAGE)
In consultation with a SiS lecturer, the SiS graduation project can be completed both internally (at the ISIS department) and externally (government, consulting firms, NGOs, etc.). In the first month, the student will write a research plan which must be approved by both the first supervisor and a second reader. Of the latter two, at least one is from the Mathematics department. The assessment of the thesis is based on the criteria described in the "Graduation project guidelines SiS".

7.2.4 Science and Education

Programme
In derogation from Article 3.3 paragraph 4 of the general part of the Master's EER, this variant has no free elective space.

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1. Mandatory components (84 EC)

Course code	Course name	EC
NWI-EDU-WI001	Geschiedenis en filosofie van de wiskunde	6
NWI-WM300	Wiskundig denken	6
NWI-WM157	Statistiek en samenleving	6
RDA-VDA-WI	Vakdidactiek A wiskunde	5
RDA-VDA-WI	Vakdidactiek B wiskunde	5
RDA-PED	Pedagogisch handelen	4
RDA-MA2-WP	Wetenschap in de educatieve praktijk	4
RDA-MA2-BS	Begeleide Stage en Integraal Oordeel	15
RDA-MA2-ZS	Zelfstandige Stage en Integraal Oordeel	15
NWI-EDU02	Methoden van Vakdidactisch Onderzoek	6
LET-EDU-MA17	Academische en Professionele Ontwikkeling 1	3
LET-EDU-MA18	Academische en Professionele Ontwikkeling 2	3
LET-EDU-MA19	Academische en Professionele Ontwikkeling 3	3
LET-EDU-MA20	Academische en Professionele Ontwikkeling 4	3

2. Elective components (16 EC)

2a. Mathematics elective components (12 EC)

To choose from courses in the Master in Mathematics. Suggestions will be included in the course guide.

2b. Pedagogical-didactic elective components (4 EC)

To choose from RDA specialisation courses, 2 EC each, course codes RDA-SP-01 up to and including RDA-SP-08

3. Master's Thesis (20 EC)

A graduation thesis (NWI-EDU03, 20 EC), to be decided in consultation with one of the ISE staff members.

Admission Requirements

In addition to Article 3.4 paragraph 3 of the general part of the Master's EER, the following admission requirements apply.

Asset type	To be followed after the successful completion of
RDA-MA2-ZS Zelfstandige Stage en Integraal Oordeel	RDA-MA2-BS Begeleide Stage en Integraal Oordeel
Academische en Professionele Ontwikkeling 2	Academische en Professionele Ontwikkeling 1
Academische en Professionele Ontwikkeling 3	Academische en Professionele Ontwikkeling 2
Academische en Professionele Ontwikkeling 4	Academische en Professionele Ontwikkeling 3

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Article 7.3 Deviating programme

If a student does not choose a specialisation, they must submit a motivated request for permission to the Examining Board for an alternative course selection for the Master's programme.

In any case, the following components from Article 7.2.1 must be part of the deviating programme:
- point 2 Mandatory components
- point 3 Philosophical component
- point 5 Final paper

Article 7.4 Additional requirements

The Master's programme content chosen by the student may, after prior permission from the Examining Board, contain a maximum of 12 EC of courses from the Bachelor's programme in Mathematics. This may consist exclusively of third-year Bachelor's courses that were not part of the specific student's Bachelor's programme.

Article 7.5 Definition of final paper

The following components count as final papers:
- Master Thesis Project Mathematics NWI-WM052C (40 EC)
- Science, Management and Innovation Research Project NWI-FMT033 (27 EC)
- Science in Society Research Project NWI-SISSTAGE (30 EC)
- Integrated Master's Research NWI-EDU03 (20 EC)

Section 8. Transitional provisions for students who started in 2022-2023 and earlier

From the year	New course(s)		Old course(s)	
2023-2024	NWI-WM068D	Noncommutative Geometry (8 EC)	NWI-WM068C	Noncommutative Geometry (6 EC)
2023-2024	NWI-WM069D	Computer Algebra (8 EC)	NWI-WM069B	Computer Algebra (6 EC)
2023-2024	NWI-WM072D	Complexity Theory (8 EC)	NWI-WM072B	Complexity Theory (6 EC)
2023-2024	NWI-WM094D	Algebraic Topology 1 (8 EC)	NWI-WM094B	Algebraic Topology 1 (6 EC)
2023-2024	NWI-WM098C	Regression Analysis (8 EC)	NWI-WM098B	Regression Analysis (6 EC)
2023-2024	NWI-WM120D	Computability Theory (8 EC)	NWI-WM120C	Computability Theory (6 EC)
2023-2024	NWI-WM126B	Data Science with Applications in Medicine and Biology (8 EC)	NWI-WM126	Biostatistics (6 EC)
2023-2024	NWI-WM139B	Analytic Methods in Number Theory (8 EC)	NWI-WM139	Analytic Methods in Number Theory (6 EC)
2023-2024	NWI-WM144B	Calculus of Variations (8 EC)	NWI-WM144	Calculus of Variations (6 EC)
2023-2024	NWI-WM150B	Category Theory and Homological Algebra (8 EC)	NWI-WM150	Category Theory and Homological Algebra (6 EC)
2023-2024	NWI-WM151B	Stochastic Simulation (8 EC)	NWI-WM151	Stochastic Simulation (6 EC)
2023-2024	NWI-WM152B	Martingales and Large Deviations (8 EC)	NWI-WM152	Martingales and Large Deviations (6 EC)
2023-2024	NWI-WM153B	Nonlinear Wave Equations (8 EC)	NWI-WM153	Nonlinear Wave Equations (6 EC)
2023-2024	NWI-WM158B	Experimental Mathematics (8 EC)	NWI-WM158	Experimental Mathematics (6 EC)
2023-2024	NWI-WM159B	Singularities and Black Holes (8 EC)	NWI-WM159	Singularities and Black Holes (6 EC)
2023-2024	NWI-WM161B	Monte Carlo Methods (8 EC)	NWI-WM161	Monte Carlo Methods (6 EC)

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2023-2024	NWI-WM246B	Optimal Transport (8 EC)	NWI-WM246	Optimal Transport (6 EC)
2023-2024	NWI-WM303B	Finite Element Methods (8 EC)	NWI-WM303	Finite Element Methods (6 EC)
2023-2024	NWI-WM304B	Sheaves and Geometry (8 EC)	NWI-WM304	Sheaves and Geometry (6 EC)
2023-2024	NWI-WM115B	Master Seminar (6 EC)	NWI-WM115C	Master Seminar (3 EC) and elective course (3 EC)
2023-2023	NWI-EDU-WI001	History and Philosophy of Mathematics (6 EC)	NWI-WM302	History and Philosophy of Mathematics (6 EC)

In addition to the courses mentioned in the various tracks (Article 8.1 points 1 a, b and c), students can also choose courses from tracks of the same name mentioned in Article 7.2.1 points 1 a, c and f.

Article 8.1 Mathematics

The Master's programme in Mathematics with the research specialisation Mathematics consists of the following components:

1. Track (30 EC)

A choice needs to be made from one of the following tracks with at least 30 EC. Courses with 'Mastermath' as a course code are provided in collaboration with Mastermath. They can be found on Mastermath's website (https://elo.mastermath.nl/).

a. Track: Pure Mathematics

Mandatory elective (30 EC) from the following courses and optional interdisciplinary synergy track (not all courses are offered every year):

	Course code	Course name	EC
1	NWI-WM150	Category Theory and Homological Algebra, or:	6
	Mastermath	Calculus of Variations or:	8
	NWI-WM144	Calculus of Variations	6
2	Mastermath	Differential Geometry, or:	8
	Mastermath	Algebraic Geometry 1	8
3	Mastermath	Lie Groups, or:	8
	Mastermath	Lie Algebras	8
4	NWI-WM094B/Mastermath	Algebraic Topology 1 or:	6/8
	NWI-WM072B/Mastermath	Complexity Theory	6/8
5	Mastermath	Riemann Surfaces, or:	8
	Mastermath	Elliptic Curves, or:	8
	NWI-WM255	Probabilistic Combinatorics	6
6	Mastermath	Operator Algebras, or:	8
	NWI-WM120C/Mastermath	Computability Theory	6/8
7	Mastermath	Algebraic Number Theory, or:	8
	NWI-WM139	Analytic Methods in Number Theory	6
8	Synergy Track Mathematics of Computer Science:		

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			6
Mandatory course (6 EC):	NWI-WM069B Computer Algebra		6
Mandatory electives (12 EC):	NWI-IMC010 Type Theory and Coq		6
	NWI-IMC011 Semantics and Domain Theory		6
	NWI-IMC036 Category Theory and Coalgebra		6
	NWI-WM158 Experimental Mathematics		6
	NWI-IMC009 Automated Reasoning		6

b. Track: Applied Mathematics

Mandatory elective (30 EC) from the following courses and optional interdisciplinary synergy track:

	Course code	Course name	EC
1	NWI-WM144	Calculus of Variations, or:	6
	Mastermath	Calculus of Variations, or:	8
	Mastermath	Measure Theoretic Probability, or:	8
	Mastermath	Numerical Linear Algebra	8
2	NWI-WM246	Optimal Transport, or:	6
	NWI-WM160	Gamma-Convergence	6
3	NWI-WM126	Biostatistics, or:	6
	NWI-WM098B	Regression Analysis and Non-Parametric Statistics	6
4	Mastermath	Mathematical Biology, or:	8
	Mastermath	Asymptotic Statistics, or:	8
	NWI-WM156	Finite Elements	6
5	NWI-WM255	Probabilistic Combinatorics, or:	6
	NWI-WM161	Monte Carlo Methods	6
6	NWI-WM152	Martingales and Large Deviations, or:	6
	Mastermath	Numerical Bifurcation Analysis of Large-scale Systems	8
7	NWI-WM153 NWI-WM151	Nonlinear Wave Equations, or:	6
		Stochastic Simulation, or:	6
	Mastermath	Partial Differential Equations	8
8	Synergy Track Mathematics and Data Science:		
	Mandatory course (6 EC):	NWI-WM098B Regression Analysis and Non-Parametric Statistics	6
	Mandatory electives (12 EC):	Mastermath Machine Learning Theory	8
		NWI-IMC030 Machine Learning in Practice	6
		NWI-NM048D CDS: Machine Learning + NWI-NM047D Computational Neuroscience*	6
		NWI-NM127 Modeling of Complex Real-world Systems	6

*These 6 EC can be replaced by: NWI-NM048B Advanced Machine Learning (6 EC)

c. Track: Mathematical Physics

Mandatory elective (30 EC) from the following courses and optional interdisciplinary synergy track:

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	Course code	Course name	EC
1	Mastermath	Differential Geometry, or:	8
	NWI-WM069B	Symplectic Geometry	6
2	NWI-WM068C	Noncommutative Geometry, or:	6
	Mastermath	Poisson Geometry	8
3	Mastermath	Lie Groups, or:	8
	Mastermath	Lie Algebras	8
4	Mastermath	Calculus of Variations, or:	8
	NWI-WM144	Calculus of Variations, or:	6
	Mastermath	Partial Differential Equations	8
5	NWI-WM153	Nonlinear Wave Equations, or:	6
	NWI-WM159	Singularities and Black Holes	6
6	Mastermath	Functional Analysis, or:	8
	Mastermath	Operator Algebras	8
7	Mastermath	Quantum Computing, or:	8
	Mastermath	Quantum Information Theory	8
8	Synergy Track Gravity+:		
	Mandatory electives (12 EC)	NWI-NM107 General Relativity	6
		NWI-NM024C Foundations and Frontiers of Gravitational Wave Astrophysics or: NWI-NM114 Quantum Gravity	6
		NWI-WM159 Singularities and Black Holes	6
		NWI-WM153 Nonlinear Wave Equations	6

2. Mandatory components (8 EC)

Course code	Course name	EC
NWI-WM115C	Master Seminar*	6
NWI-WM301	Professional Preparation for Math	2

*Students who choose the synergy track Mathematics of Computer Science may replace NWI-WM115C Master Seminar (6 EC) by NWI-IMC057 MFoCS Seminar (6 EC). *Students who choose the synergy track Gravity+ may replace NWI-WM115C Master Seminar (6 EC) by NWI-WM115B Master Seminar (3 EC) + NWI-NM124 Gravity+ Club (3 EC).*

3. Mathematical electives (18 EC)

The students must take 18 EC of mathematics courses at the Master's level. This package must be presented to the Examining Board for approval.

4. Master Electives (15 EC)

The students must take 15 EC of courses at the Master's level, within or outside the field of mathematics. This package must be presented to the Examining Board for approval.

5. Philosophical component (3 EC)

The student must follow at least 3 EC courses of a philosophical nature at Master's level. Courses from the table below have been pre-approved.
NB: Not all courses are offered annually, and some are subject to enrolment restrictions.

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Course code	Course name	EC
NWI-FFIL212	Philosophy of Water Management	3
NWI-FFIL215	Upgrading the Human?	3
NWI-FFIL216	Imagining the Anthropocene	3
NWI-FFIL217	Science and Arts	3
NWI-FFIL218	Science and Values	3
NWI-FFIL219	Philosophy of Neuroscience	3
NWI-FFIL220	Philosophy of Evidence and Expertise	3
NWI-FFIL302	Philosophy and Ethics in Microbiology	3
NWI-FFIL202A	Evolution and the Mind	3
NWI-FFIL203B	Bio-ethics for Life Scientists	3
NWI-FFIL209B	Environmental Ethics	3
NWI-FFIL211B	Physics and Philosophy	3
NWI-WM302	History and Philosophy of Mathematics	3 or 6
Mastermath	History and Philosophy of Mathematics	8
NWI-FFIL220	Philosophy of Evidence and Expertise	3
NWI-FFIL221	Compete or Collaborate? - An Introduction to Disciplines and Interdisciplinarity	3

* No longer offered

6. Free electives (6 EC)

7. Master Thesis Project Mathematics NWI-WM052C (40 EC)

In line with the major, consisting of conducting a literature study, writing a thesis and making a final presentation. The thesis can consist of an internship report. Research or internships may be completed outside of the Mathematics department, but the first assessor needs to be from the department. A plan needs to be drafted in consultation with the first assessor prior to commencement of the research or internship.

For students of the specialisation in Science in Society, the following applies:

- Students who have already successfully completed FC003B (Research, Responsibility and Uncertainty) and NWI-FC002B Science and Societal Interaction may use these courses instead of NWI-FC0045 Science & Public Participation.
- Students who have already successfully completed NWI-FFIL218 Science & Media may use this course as Societal Elective in Q2.
- Students who have already successfully completed NWI-FFIL219 Philosophy of Neuroscience may use this course as Philosophy Elective in Q1.
- The students from the 2021 cohort and earlier can choose NWI-FFIL300C Philosophy of Mathematical Practice as a philosophy elective.

In the Science, Management and Innovation specialisation:

- Students who have successfully completed NWI-FMT020 Bio-Economy may use it instead of one of the 3 EC courses in the Climate and Energy theme.

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- Students who have successfully completed NWI-FMT025B From Lab to Clinic may use it instead of NWI-FMT029 How Health Systems Work.
- Students who have successfully completed NWI-FMT024 Policy and Economics *and* NWI-FMT006A Entrepreneurship may use it instead of NWI-FMT030 Reaching the SDGs.
- Students who have successfully completed NWI-FMT006A Entrepreneurship but *not* NWI-FMT024 Policy and Economics can place it in the free elective space *or* follow NWI-FC0043B Science and Public Policy with which they may use NWI-FMT006A Entrepreneurship and NWI-FC0043B Science and Public Policy together instead of NWI-FMT030 Reaching the SDGs.
- Students who have successfully completed NWI-FMT024 Policy and Economics but *not* NWIFMT006A Entrepreneurship can place this in the free elective space.
- Students who have successfully completed NWI-MM020A Environmental Life Cycle Assessment and a 3 EC free elective may use it instead of NWI-FMT032 Environmental Life Cycle Assessment.

For students who specialised in Science and Education before the 2023-2024 academic year, the following applies:

Asset type	To be replaced by
RDA-MA2-02 Leren en Instructie 1 (2 EC)	RDA-VDA-WI-A Vakdidactiek A wiskunde (variant, 2 EC)
RDA-MA2-04 Leren en Instructie 2 (2 EC)	RDA-SP-01 Specialisatiecursus Formatief handelen
RDA-MA2-21 Leren en Instructie 3 (3 EC)	RDA-VDA-WI-B Vakdidactiek A wiskunde (variant, 3 EC)
RDA-MA2-06 Oriëntatie op Pedagogische Professionaliteit (3 EC)	RDA-PED-A Pedagogisch handelen (variant, 3 EC)
RDA-MA2-08 Handelen vanuit pedagogische professionaliteit (2 EC)	RDA-PED-B Pedagogisch handelen (variant, 2 EC)
RDA-MA2-20 and RDA-MA2-15 Intensification themes (2 x 1 EC)	RDA-SP-01 up to and including RDA-SP-08 Specialisation course (2 EC)
LET-EDU-MA11 Academische en Professionele Ontwikkeling 1 (2 EC)	LET-EDU-MA17-A Academische en Professionele Ontwikkeling 1 (variant, 2 EC)
LET-EDU-MA12 Academische en Professionele Ontwikkeling 2 (2 EC)	LET-EDU-MA18-A Academische en Professionele Ontwikkeling 2 (variant, 2 EC)

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PART IV   FINAL PROVISIONS

Section 9. Final provisions

Article 9.1 Safety net scheme and hardship clause
1. In all cases not covered fully or clearly by these regulations, the decision lies with the dean.
2. In all cases in which these regulations may result in an unreasonable or unfair situation for individual students, the Examining Board or the dean is authorised to make an exception to the provisions in these Education and Examination Regulations.

Article 9.2 Establishment and amendments
1. Contrary to the provisions in Article 7 of the Structure Regulations, these regulations are drawn up or amended by the dean after receiving advice from the programme committees and after having obtained the approval of the Joint Assembly of the faculty.
2. An amendment to these regulations has no impact on the current academic year, unless this would disproportionately damage the interest of the students.
3. Contrary to paragraph 1, the dean is authorised to drop elective components from the curriculum should the circumstances be deemed impossible for offering these courses.

Article 9.3 Entry into force
These regulations enter into force on 1 September 2023.

Article 9.4 Publication
1. The dean is responsible for publishing these regulations and any amendments thereto.
2. Interested parties may consult these regulations via the prospectus.

As established by the dean on 26-06-2023.

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Appendix 1: Guideline for awarding distinctions

a. With due observance of the provisions set out in this Article, the Examining Board is responsible for the decision of whether a distinction shall be awarded and if so, which distinction.

b. The distinction shall be calculated on the basis of all components of the examination programme for which a mark has been awarded on a scale from 1 to 10, with the exception of extra-curricular components.

c. The number of EC of the component referred to in paragraph b shall serve as the weighting factor for the calculation of the weighted average result, unless stipulated otherwise in the programme-specific part of the EER.

d. The distinction 'cum laude' shall be awarded if the weighted average result of the final assessment of the components referred to in paragraph b is equal to or higher than 8.0.
Both the EC-weighted average of the assessments of all exam parts with a size of **less than 20 EC** and the EC-weighted average of the assessments of all exam parts with a size **equal to or more than 20 EC** must be at least 8.0 before any rounding off.

e. The distinction 'summa cum laude' shall be awarded if the weighted average result of the final assessment of the components referred to in paragraph b is at least 9.0.
Both the EC-weighted average of the assessments of all exam parts with a size of **less than 20 EC** and the EC-weighted average of the assessments of all exam parts with a size **equal to or more than 20 EC** must be at least equal to 9.0 before any rounding off.

f. A distinction shall not be awarded if more than 10% of the total study load of the examination programme (being one or more components) has been resat, unless the Examining Board decides otherwise, stating the reasons for this decision.

g. A distinction shall not be awarded if exams have been resat more than once, unless the Examining Board decides otherwise, stating the reasons for this decision.

h. A distinction is not granted if the extent of the granted exemption includes more than 50% of the programme, considering possible further restrictions to the number exemptions as stated in the EER.

i. The distinction shall not be awarded if fraud was discovered in one of the exams of the examination programme.

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Appendix 2: Fraud Regulations

Section 1. Introductory provisions

Article 1. Objective and scope of the regulations

The Dean of the Faculty of Science at Radboud University has drawn up the following regulations with a view to preventing fraud during interim and final examinations as referred to in Article 7.12b of the Higher Education and Research Act (Wet op het Hoger onderwijs en Wetenschappelijk onderzoek (hereinafter: WHW)) that are part of the teaching and exams of the study programmes in the Faculty of Natural Sciences, Mathematics and Computer Science at Radboud University.

Article 2. Definitions

The terms that are used in these regulations – in so far as these terms are also used in the WHW or the Education and Examination Regulations of the degree programme (hereinafter: the EER) – have the same meaning that is given to these terms in the WHW and the EER.

Section 2. Definition of fraud, procedure and sanctions

Article 3. Definition of fraud

1. At Radboud University, fraud is understood to mean any act or omission by a student which, by its nature, is intended to render the proper assessment of the knowledge, understanding and skills of that student or another student fully or partially impossible.
2. Fraud in general is defined as:
    a. Fraud when taking written interim and final exams, including:
        i. Having access to unauthorised aids as referred to in the House Rules for Radboud University Examination Rooms;
        ii. Looking at the work of others or exchanging information;
        iii. Impersonating someone else or allowing someone else to impersonate oneself during an interim or final exam.
    b. Committing fraud when writing theses or other papers or completing assignments, including:
        i. Plagiarism in the sense of using or copying someone else's texts, data or ideas without complete and correct references to sources, plagiarism in the sense of copying the work of another student and presenting this as one's own work and other specifically academic forms of plagiarism;
        ii. The fabrication or falsification of research data;
        iii. The submission of a thesis or other paper that has been written by someone else.
    c. Other fraud during examination, including:

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       i.   Taking possession of assignments, answer keys and the like, prior to the time the exam takes place;

      ii.   Changing answers to questions on an examination after it has been submitted for assessment;

     iii.   Providing incorrect information when requesting exemption, an extension of the validity period, and other similar requests regarding an examination.

3. Any attempt at fraud will also be considered fraud in the sense of these regulations.

Article 4. Procedure for determining fraud

1. In the event that fraud is suspected, the Examining Board or the examiner will immediately inform the student. If fraud is suspected while an exam is being given, then the Examining Board or the examiner will provide the student with the opportunity to complete the exam.
2. The Examining Board or the examiner may order the student to provide the materials involved in the suspicion of fraud.
3. For the application of the provisions in paragraphs 1 and 2, 'examiner' is understood to mean the invigilator or another Radboud University staff member.
4. The Examining Board or the examiner will draw up a report of the suspected fraud. If the examiner draws up the report, they will send it to the Examining Board immediately.
5. The Examining Board will immediately make the report referred to in paragraph 4 available to the student and will begin an investigation into it. The Examining Board will provide the student with the opportunity to respond to the report in writing. The Examining Board will hear both the examiner and the student.
6. Within four weeks of making the report available to the student, the Examining Board will determine whether there is evidence of fraud. The Examining Board will inform both the student and the examiner of its decision in writing. The period of four weeks may be extended by two weeks.

Article 5. Remedial measures

If the Examining Board determines that fraud has been committed:
   a.   The Examining Board will declare that the relevant exam taken by the student (or students) in question is considered invalid, and;
   b.   It will document the identification of fraud and, if applicable, the sanctions imposed in the student's file.

Article 6. Sanctions

1. If the Examining Board determines an instance of fraud, it is able to:
     a.   Decide that the student is no longer able to sit for one or more exams during a period to be defined by the Examining Board, being no longer than a year;
     b.   Decide that no distinction will be granted on the student's diploma;
     c.   Make a recommendation to the Dean of the Honours Academy that the student should not be admitted to the honours programme of the university or the faculty, or

recommend that the student's participation in the honours programme of the university or the faculty be terminated.

2. If the Examining Board establishes that serious fraud has been committed:
   a. the Examining Board can recommend to the Executive Board that the student's enrolment in a study programme be definitively terminated;
   b. The Executive Board may definitively terminate the student's enrolment in a study programme at the suggestion of the Examining Board.
3. As described in the Distinction Guidelines, a distinction will not be awarded if fraud has been detected in one or more of the components in the entire examination programme.
4. The sanctions as specified in this provision will be imposed on the day following the date on which the student has been informed of the decision to impose the sanctions.

Section 3. Transitional provisions

Not applicable.

Section 4. Final provisions

Article 7. Decisions and legal protection

1. Decisions on the basis of these regulations may be sent to the student digitally or by email.
2. For decisions based on these regulations, the student is permitted to appeal the relevant decision with the Examination Appeals Board (EAB) within six weeks of the decision date.

Article 8. Adoption and amendments

1. This scheme is adopted and amended by the dean.
2. If the content of these regulations relates to duties and powers of the Examining Board of the study programme, that content must be approved by that Examining Board.

Article 9. Entry into force

These regulations enter into force on 1 September 2023. On that date, these regulations will replace the preceding regulations.

Article 10. Publication

1. The dean is responsible for publishing these regulations and for appropriately disclosing any amendments thereto.
2. For the purpose of proper and clear provision of information to students and prospective students, the dean includes these regulations as an appendix to the Education and Examination Regulations (Onderwijs- en Examenreglement (EER)).

As determined by the dean on 26-06-2023 and ratified by the Examination Board on 10-07-2023.

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