

Education and Examination Regulations 2021–2022

Master's in Mathematics

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PART I GENERAL PROVISIONS

Section 1. General provisions

Article 1.1 Applicability of these regulations

1. These Education and Examination Regulations (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 2021–2022 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 was active at the time of their initial enrolment in the programme.
3. Course components provided by different 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 EERs of the Faculty of Science at all times.
4. The faculty offers the following 120-EC Master's programmes:
 - a. Biology;
 - b. Chemistry (being phased out);
 - c. Computing Science;
 - d. Mathematics;
 - e. Medical Biology;
 - f. Molecular Life Sciences (being phased out);
 - g. Molecular Sciences
 - h. Physics and Astronomy;
 - i. Science (being phased out);
5. The faculty offers the following 60-EC Master's programmes:
 - a. Information Sciences.
6. All degree programmes are offered exclusively as full-time programmes.
7. The programmes are taught in English. The exception to this is the educational components of the Faculty of Science Education and Science specialisations that are taught in Dutch.

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Article 1.2 Executive Board Guidelines

1. In view of the organisation and coordination of the provisions in these regulations, the Executive Board has established the following guidelines: The guidelines can be found in the Appendix:
 - a. Guideline for regulations on academic distinctions;
2. In addition to the above guidelines, the Executive Board has established a number of temporary guidelines for the 2021–2022 academic year in response to the coronavirus measures. These guidelines are available at <https://www.ru.nl/nieuws-agenda/nieuws/coronavirus-radboud-universiteit/coronarichtlijnen/>.

Article 1.3 Definition of terms

1. The terms used in these EER, which 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 clause 1, the terms below are understood to have the following meanings:
 - a. Degree programme: the Master's degree programme referred to in Article 7.3a, clause 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 clause 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 clause f. In these regulations, when the term 'examination' is used, this can also be read as 'partial examination', unless explicitly indicated otherwise;
 - h. Resit: a new opportunity to retake a particular examination as referred to in Article 7.10 clause 1 of the Higher Education and Research Act (WHW). In these regulations, when the term 'examination' is used, this can also be read as 'resit', unless explicitly indicated otherwise;

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- 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. Fraud: any deliberate act or omission by a student that makes forming an accurate opinion of their knowledge, understanding and skills partially or entirely impossible. The Regulations on Fraud during Interim Examinations and Examinations are included as an appendix to these EER;
- k. 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;
- l. Examiner: the person designated by the Examining Board to administer the interim examinations, in accordance with Article 7.12 of the Act;
- m. EC: European Credits, i.e. the study load unit in accordance with the European Credit Transfer
- n. 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
- q. University as collective holidays;
- r. Awarding of the degree certificate: the formal confirmation that all the examination requirements have been met;
- s. Prospectus: the guide for a particular Faculty of Science degree programme,
- t. containing specific information regarding the Master's degree programme;
- u. The University: Radboud University;
- v. The faculty: The Faculty of Science;
- w. The education institute: the organisational unit responsible for the degree programme;
- x. Free elective: a freely-selected, academic, assessable component.
- y. 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. A 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),
 - b. Ireland, New Zealand, Singapore, the United Kingdom, the United States or South
 - c. Africa; or
 - d. is in possession of a pre-university education (VWO) diploma; or
 - e. is in possession of a pre-university education diploma obtained at an English-language institution in the Netherlands or elsewhere; or
 - f. has a pre-university education diploma obtained at a German secondary education institution, with English as *Grundkurs*; or
 - g. has a Bachelor's diploma from a university of applied sciences (HBO); or
 - h. has a Bachelor's diploma from a Dutch university; or
 - i. meets the requirements in the opinion of the programme; or
 - j. has achieved a sufficient score on one of the following English language tests:
 - 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
 - iv. 6.0;
 - v. the Cambridge CAE or CPE with a score of C or higher.
2. A 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.

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Section 3. Structure and design

Article 3.1 Final examination, degree and distinctions

1. The degree programme is concluded by the Master's final examination.
2. Students who pass the examinations of the Master's degree programme will be awarded a Master of Science (MSc) degree.
3. The degree referred to in the second clause is exclusively awarded 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 a distinction can be found in Article 4.7 of these EER.

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 must make a course guide available prior to the course, which includes a description of the course, tests with weighting factors and deadlines. This guide may coincide with the course description in the study guide.
3. The programme has research specialisations and societal specialisations. The specialisations are described in the programme-specific part.
4. 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 0 or 1 EC.
5. The elective courses cannot have substantial overlap in content with courses from the mandatory or elective components of the programme. It is not possible to receive an exemption for the elective component based on a Bachelor's course.
6. 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.

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7. 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. Students can only participate in the Science in Society research project after 12 EC have been obtained from the SiS curriculum.
8. Students are permitted to add components to the examination programme. These components are considered extra-curricular and do not count towards the determination of the distinction.
9. If a student can choose 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 towards their distinction.

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;
 - c. Presentation;
 - d. Skill test and/or the creation of a discipline-specific product and/or assignment.
2. Prior to the commencement of the academic year, information will be provided in the prospectus for each individual component regarding the way in which the interim examinations will be administered. At the request of the student or the examiner, the Examination Board may allow an interim examination to be administered in a form other than stated above, 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 6. 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 disabilities are given the opportunity to take interim examinations in a manner appropriately suited to their disability. The Examining Board, if necessary, shall 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 Education and Examination Administration of the faculty no later than two weeks before the interim examination or resit.

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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. All oral examinations are recorded. A second examiner or a designated observer may be present as an alternative to recording.

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 diploma as an exemption.
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 clause 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 EC 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. Results obtained for interim examinations are valid until the end of the academic year at least. Lecturers can decide to extend the term of the validity of the result obtained for a partial examination.

Article 3.7 Elective programmes

The programme Examination Board shall decide on a request for authorisation to follow a free education programme as referred to in Article 7.3d 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.

Section 4. Testing

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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 clause, 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 23:59 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. A successfully passed examination may be taken again.
3. If a student resits an interim examination, the most recent result will determine the final result.

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 in the form of a grade, the assessments 'completed', 'not completed', 'satisfactory', 'not satisfactory', and 'good' may also be awarded.
2. Notwithstanding the provisions of clause 1, partial examinations may also be graded with one decimal point on a 10-point scale. Only the final grade is rounded off.

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 in <http://thesissubmission.science.ru.nl>.

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2. The examiner shall determine the result of an interim examination within 15 working days of the date it 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 ten working days. This is not possible for interim examinations in the fourth period.
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 the 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 the first paragraph 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

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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 takes 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 Guideline for 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 evaluating 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 degree programme and education

Article 6.1 Admission requirements

Admission requirements for the programme:

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1. Students must have successfully passed the final examination of the Bachelor's programme in Mathematics at Radboud University.
2. Students must have successfully passed the final examination of the Bachelor's programme in (Technical) Mathematics at Radboud University or an equivalent degree at another Dutch university.
3. Students must 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,
4. 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-WB104 Topologie.
5. Students must be in possession of a degree certificate that is at least equivalent to the degrees referred to in paragraphs a, b and c.
6. Students must have demonstrated suitability for participation in the degree programme, in the opinion of the Examining Board.
7. Students meeting the requirements mentioned under d. or e. 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 learning outcomes:

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. 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 scientific 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.

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8. Graduates are able to communicate with their peers on scientific knowledge, both at a basic and 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 7.2a):

1. Graduates have a broad and in-depth overview of the main theme of the Master’s specialisation, and profound knowledge of *capita selecta* in connection to the subject of the Master’s thesis.
2. Graduates are able to independently inform themselves of developments in Mathematics by a review of literature.
3. Graduates 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 7.2b):

Graduates are:

1. Able to bridge between their own scientific discipline and other disciplines, based on profound understanding of the chosen core theme and how this relates to societal, political, economic, and environmental requirements of today’s world.
2. Familiar with and able to analyse specific problems within their theme, and able to apply a range of approaches to address these, argue for, select and implement feasible options, taking into account the full breadth of technological, societal, political and economic perspectives.
3. Proficient in using research methods and techniques, including basic finance and economics, to verify, justify and substantiate strategies and plans, and capable of effectively using a wide variety of information and communication channels.
4. Able to balance perspectives and interests in specific contexts within a company or (non)governmental organisation in order to formulate appropriate strategies and plans towards implementation of the Sustainable Development Goals (SDGs).

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5. Able to communicate insights, views and analyses of complex issues to others in a clear, concise and understandable manner, both in written and spoken form.
6. Able to work in multidisciplinary and multicultural high-performance teams based on sound division of tasks, knowledge, competencies, and responsibilities, whilst respecting diverging views and opinions.

Specialisation 'Science in Society' (as described in Article 7.2c):

Graduates are:

1. Able to analyse the role of scientific expertise in societal and political decision making with regard to socio-scientific issues
2. Able to design and conduct independent and methodologically sound social research at the interface of science and society and capable of contributing to academic research
3. Able to understand and design public and stakeholder participation processes in research and innovation
4. Able to analyse, improve and evaluate interdisciplinary collaborations with multiple stakeholders, integrating different perceptions, interests and types of knowledge
5. (experiential, professional and scientific)
6. Able to substantiate and communicate the relevance of their scientific discipline in society

Specialisation 'Science and Education' (as described in Article 7.2d):

Graduates:

1. Have knowledge of and insight into the theoretical principles of discipline-specific thinking, educational design, and the methods and techniques of applying didactic research in the discipline.
2. Are able to design, implement and systematically evaluate an educational design and a scientific study, drawing a link between didactic and professional practice concepts, discipline-specific thinking of the students at different levels and problems from teaching practice.
3. Are able to devote attention to discipline-specific learning of individual and unique students and focus on developing inspiring education.
4. Are able to apply thorough scientific knowledge on general didactic concepts about the learning of individual students and on methods to improve both the social climate in the classroom and to answer the individual learning needs of the students;
5. Are able to act in a differentiated way and improve the social climate for collaboration and, in doing so, set independent priorities and, after consultation with relevant third parties, respond appropriately to development and behavioural problems;

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6. Focus on collaboration and responsible behaviour based on clear communication with individual students and colleagues, on the basis of a personal vision;
7. Are able to develop a personal professional knowledge base to justify their own actions and understand the actions of colleagues and supervisors;
8. Are able to use the professional knowledge base and contextual feedback (students, colleagues, supervisors) to evaluate and guide their own professional development;
9. Are able to develop a personal identity in the context of their own actions, external frameworks and ethical dilemmas.

Article 7.2 Composition of the programme

Subject to the provisions in Part II of these regulations, the student chooses one of the following specialisations of the degree programme:

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

Artikel 7.2a 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 selection (30 EC) from the following courses and optional interdisciplinary synergy track:

| | Course code | Course name | EC |
|---|-------------|--|----|
| 1 | NWI-WM150 | Category Theory and Homological Algebra, or: | 6 |
| | 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 |

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| | | | |
|---|--|---|-------------|
| 4 | NWI-WM094B/Mastermath NWI-WM072B | Algebraic Topology 1, or: Complexity Theory | 6/8 6 |
| 5 | MasterMath MasterMath NWI-WM255 | Riemann Surfaces, or: Elliptic Curves, or: Probabilistic Combinatorics | 8 8 6 |
| 6 | MasterMath NWI-WM120C/Mastermath | Operator Algebras, or: Computability Theory | 8 6/8 |
| 7 | MasterMath NWI-WM139 | Algebraic Number Theory, or: Analytic Methods in Number Theory | 8 6 |
| 8 | Synergy Track Mathematics of Computer Science: | | |
| | 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 selection (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 | 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 | Nonlinear Wave Equations, or: | 6 |
| | NWI-WM151 | 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 |

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| | | |
|------------------------------|--|---|
| Mandatory electives (12 EC): | MasterMath Machine Learning Theory | 8 |
| | NWI-IMC030 Machine Learning in Practice | 6 |
| | NWI-NM048D Machine Learning + NWI-NM047D Computational Neuroscience* | 6 |
| | NWI-NM127 Modelling 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 selection (30 EC) from the following courses and optional interdisciplinary synergy track:

| | Course code | Course name | EC |
|---|-----------------------------|---|----|
| 1 | MasterMath NWI-WM069B | Differential Geometry, or: | 8 |
| | | Symplectic Geometry | 6 |
| 2 | NWI-NM0107 MasterMath | Non-commutative Geometry, or: | 6 |
| | | Poisson Geometry | 6 |
| 3 | MasterMath MasterMath | Lie Groups, or: | 8 |
| | | Lie Algebras | 8 |
| 4 | NWI-WM144 MasterMath | Calculus of Variations, or: | 6 |
| | | Partial Differential Equations | 8 |
| 5 | NWI-WM153 NWI-NM018B | Nonlinear Wave Equations, or: | 6 |
| | | Singularities and Black Holes | 6 |
| 6 | MasterMath MasterMath | Functional Analysis, or: | 8 |
| | | Operator Algebras | 8 |
| 7 | MasterMath MasterMath | Quantum Computing, or: | 8 |
| | | Quantum Information Theory | 8 |
| 8 | Synergy Track Gravity+: | | |
| | Mandatory electives (12 EC) | NWI-NM0107 General Relativity | 6 |
| | | NWI-NM024C Gravitational Waves, or: NWI-NM114 Quantum Gravity | 6 |
| | | NWI-NM018B Singularities and Black Holes | 6 |
| | | NWI-WM153 Nonlinear Wave Equations | 6 |

2. Compulsory 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-WM115B Master Seminar (6 EC) by WM115B Master Seminar (3 EC) + NWI-IMC049 MFoCS Seminar (3 EC).

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*Students who choose the synergy track Gravity+ may replace NWI-WM115B Master Seminar (6 EC) by WM115B Master Seminar (3 EC) + NWINM124 Gravity+ Seminar (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 Examination 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 Examination Board for approval.

5. Philosophical component (3 EC)

| Course code | Course name | EC |
|--------------|---------------------------------------|-------|
| NWI-WM302 | History and Philosophy of Mathematics | 3 / 6 |
| NWI-FFIL300C | Philosophy of Mathematical Practice | 3 |

6. Free space for electives (6 EC)

7. Graduation phase (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.

Article 7.2b 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 of at least 24 EC, as outlined in Article 7.2a point 1.

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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 Examination Board for approval.

3. Compulsory 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-WM115B Master Seminar 3 EC + NWI-IMC049 MFoCS Seminar (3 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+ Seminar (3 EC).

4. Philosophical component (3 EC)

| Course code | Course name | EC |
|--------------|---------------------------------------|----|
| NWI-WM302 | History and Philosophy of Mathematics | 3 |
| NWI-FFIL300C | Philosophy of Mathematical Practice | 3 |

5. Free space for electives (6 EC)

6. Specialisation (57 EC)

a. Compulsory 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

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| 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 elective | 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 | Environmental and Ecological Concepts | 3 |
| NWI-BM075 | Biodiversity Assessment | 3 |
| NWI-BM033F | Nature in a Crowded Country | 3 |
| NWI-FMT032 | Environmental Life Cycle Assessment | 6 |

c. Science, Management and Innovation final research project (27 EC)

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The SMI research project may, in consultation with the coordinator or a lecturer from the SMI specialisation, be completed both internally (at the Faculty of Science) or externally (government, businesses, consulting firms, NGOs, etc.), at home or abroad. In the first month, the student will write a research plan which must be approved by both the external supervisor and first assessor, 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*'.

Article 7.2c 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 majors of at least 24 EC, as described in Article 7.2a point 1.

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 Examination Board for approval.

3. Compulsory 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-WM115B Master Seminar 3 EC + NWI-IMC049 MFoCS Seminar (3 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+ Seminar (3 EC).

4. Philosophical component (3 EC)

| Course code | Course name | EC |
|--------------|---------------------------------------|-------|
| NWI-WM302 | History and Philosophy of Mathematics | 3 / 6 |
| NWI-FFIL300C | Philosophy of Mathematical Practice | 3 |

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5. *Free space for electives (6 EC)*

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

6. *Specialisation (57 EC)*

a. *Compulsory courses (24 EC)*

| Course code | Course name | EC |
|-------------|--|----|
| NWI-FC002B | Science and Societal Interaction | 3 |
| NWI-FC003B | Research, Responsibility and Uncertainty | 3 |
| NWI-FC0010D | Framing Knowledge | 6 |
| NWI-FC0013C | Science and Media | 3 |
| NWI-FC0043B | Science and Public Policy | 3 |
| NWI-FC0044C | Methods of Societal Research: Science in Society | 6 |

b. *Limited choice electives (3 EC)*

To be filled with components related to the topic of the thesis. These components must be presented for approval to the SiS coordinator.

c. *Science in Society internship and report (30 EC)*

In consultation with a SiS lecturer, the SiS graduation project can be completed both internally (at the ISIS department) or external (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 as well as 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*'.

Article 7.2d Science and Education

1. *Compulsory components (106 EC)*

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| Course code | Course name | EC |
|--------------|--|----|
| RDA-MA2-01 | Visie op het schoolvak, wetenschapsgebied en onderwijs | 3 |
| RDA-MA2-02 | Leren en instructie 1: effectieve lessen vanuit meerdere perspectieven | 2 |
| RDA-MA2-03 | Persoonlijk leiderschap van de docent en professioneel spreken | 1 |
| RDA-MA2-04 | Leren en instructie 2: het leren zichtbaar maken door leraren | 2 |
| RDA-MA2-06 | Oriëntatie op de pedagogische professionaliteit van leraren | 3 |
| RDA-MA2-21 | Leren en instructie 3: vakdidactische oriëntatie op leerproblemen en instructiestrategieën | 3 |
| RDA-MA2-08 | Handelen vanuit pedagogische professionaliteit: creëren van een veilig en krachtig leerklimaat | 2 |
| RDA-MA2-13 | Leren en instructie 4: leren innoveren in het schoolvak | 4 |
| RDA-MA2-16 | Teacher Leadership | 4 |
| RDA-MA2-09 | Supervised internship 1 | 7 |
| RDA-MA2-10 | Supervised internship 2 | 7 |
| RDA-MA2-11 | Independent internship 1 | 8 |
| RDA-MA2-12 | Independent internship 2 | 8 |
| NWI-WM157 | Statistics in Society** | 6 |
| LET-EDU-MA11 | Academic and Professional Development 1 | 2 |
| LET-EDU-MA12 | Academic and Professional Development 2 | 2 |
| LET-EDU-MA13 | Academic and Professional Development 3 | 2 |
| LET-EDU-MA14 | Academic and Professional Development 4 | 2 |
| NWI-EDU02 | Methoden van Onderzoek | 6 |
| NWI-WM... C | History and Philosophy of Mathematics** | 6 |
| NWI-EDU03 | Geïntegreerd masteronderzoek | 20 |
| NWI-WM300 | Mathematical Thinking and Applications** | 6 |

** Master's degree course for Teachers

2. RDA electives (2 EC)

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This differs per period. Deepening theme 1 (RDA-MA2-15, 1EC) is offered in period 2 of year 2. Deepening theme 2 (RDA-MA2-20, 1EC) is offered in period 4 of year 2.

3. Mathematics elective course (12 EC)

Free selection from the Mathematics Master's course.

Article 7.3 Deviating programme

If a student does not choose a specialisation, they must submit a motivated request for permission to the Examination Board for an alternative major selection before the start of the Master's programme.

Article 7.4 Additional requirements

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

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Section 8. Transitional provisions

- NWI-WM115C Master Seminar (6 EC) may be replaced by NWI-WM115B Master Seminar (3 EC), provided it was followed in 2017-2018 or earlier.
- Students who started the Master's in Mathematics degree programme before 1 September 2020 may choose from the specialisations as outlined in the EER of their starting year or from the EER 2020–2021.
- Students who started the Master Mathematics before 1 September 2020 may choose the following courses as part of the major Applications: NWI-WM154 Numerical Methods for PDE (6EC), NWI-WM098B Regression Analysis and Non-Parametric Statistics (6EC) en NWI-WM126 Biostatistics (6EC).
- Students who started the Master's in Mathematics before 1 September 2020, may replace the following compulsory components from Article 7.2d point 1 by mathematic electives: Geïntegreerd masteronderzoek (NWI-EDU02, 20 ec), Statistics in Society (NWI-WM157, 6 ec), Geschiedenis en Grondslagen van de Wiskunde (NWI-WB019C, 6 ec).

For students of the specialisation in Science, Management and Innovation the following applies:

- 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.
- 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 Clinic 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* NWI-FMT006A 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 started in 2020–2021 academic year (or earlier):

1. The following courses are allowed per track:

Pure Mathematics Track:

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| | Course code | Course name | EC |
|---|-------------|-----------------------------------|----|
| 7 | MasterMath | Algebraic Number Theory, or: | 8 |
| | MasterMath | Analytic Number Theory, or: | 8 |
| | NWI-WM139 | Analytic Methods in Number Theory | 6 |

Applied Mathematics Track:

| | Course code | Course name | EC |
|---|-------------|---|----|
| 1 | NWI-WM144 | Calculus of Variations, or: | 6 |
| | NWI-WM160 | Gamma-Convergence | 6 |
| 2 | MasterMath | Partial Differential Equations, or: | 8 |
| | MasterMath | Measure Theoretic Probability, or: | 8 |
| | MasterMath | Numerical Linear Algebra | 8 |
| 4 | MasterMath | Mathematical Biology, or: | 8 |
| | MasterMath | Asymptotic Statistics, or: | 8 |
| | MasterMath | Numerical Bifurcation Analysis of Large-scale Systems | 8 |
| 5 | NWI-WM151 | Stochastic Simulation, or: | 6 |
| | NWI-WM161 | Monte Carlo Methods | 6 |
| 6 | NWI-WM152 | Martingales and Large Deviations, or: | 6 |
| | MasterMath | Probabilistic and Extremal Combinatorics | 8 |
| 7 | NWI-WM153 | Nonlinear Wave Equations, or: | 6 |
| | NWI-WM156 | Introduction to Finite Elements | 6 |

2. The following two tracks are allowed:

Track: Mathematics and Computation:

Mandatory selection (30 EC) from the following courses:

| | Course code | Course name | EC |
|---|-------------|--|----|
| 1 | NWI-WM069B | Computer Algebra | 6 |
| 2 | NWI-WM072B | Complexity Theory | 6 |
| 3 | NWI-WM120C | Computability Theory, or: | 6 |
| | MasterMath | Computability Theory | 8 |
| 4 | MasterMath | Probabilistic and Extremal Combinatorics | 8 |
| 5 | NWI-WM150 | Category Theory and Homological Algebra | 6 |
| 6 | NWI-IMC010 | Type Theory and Coq | 6 |
| 7 | NWI-IMC011 | Semantics and Domain Theory | 6 |

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|---|-----------|---------------------------------|---|
| 8 | NWI-WM156 | Introduction to Finite Elements | 6 |
| 9 | NWI-WM158 | Experimental Mathematics | 6 |

Track: Gravity+ Synergy (30 EC):

Compulsory components (18 EC):

| Course code | Course name | EC |
|-------------|-------------------------------|----|
| NWI-WM115B | Master Seminar | 3 |
| NWI-NM124 | Gravity+ Seminar | 3 |
| NWI-NM0107 | General Relativity | 6 |
| NWI-NM018B | Singularities and Black Holes | 6 |

Mandatory selection (12 EC) from the following courses:

| Course code | Course name | EC |
|-------------|---------------------------|----|
| NWI-WM115B | Non-linear Wave Equations | 6 |
| NWI-NM124 | Calculus of Variations | 6 |
| NWI-NM0107 | Non-commutative Geometry | 6 |
| MasterMath | Riemann Surfaces | 8 |
| MasterMath | Differential Geometry | 8 |

- The course NWI-WM301 Professional Preparation for Math (2 EC) may be replaced by NWI-NM019B Professional Preparation (1 EC).
- For the philosophical component, the following course is allowed: NWI-WM040B Philosophy of Mathematics (3 EC).
- Students who choose the track Mathematics and Computation may replace this by NWI-WM115B Master Seminar (3 EC) + NWI-IMC049 MFoCS Seminar (3 EC).
- Students who choose the synergy track Gravity+ may replace NWI-WM115B Master Seminar (6 EC) by WM115B Master Seminar (3 EC) + NWI-NM124 Gravity+ Seminar (3 EC).

For students who started in the 2020-2021 academic year, the following applies for the Science and Education specialisation:

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- mathematics elective courses 18 EC (instead of 12 EC), and 12 EC of Master's degree courses (the courses in 7.2.d point 1 are marked with **).

This is the curriculum for students who started the programme before the 2020–2021 academic year: The Master's programme in Mathematics with a Science and Education specialisation consists of the following components:

1. Mathematical electives (44 EC)

The students must take 44 EC of mathematics courses at the Master's level. This course package must be presented to the Examination Board for approval.

2. Compulsory components (7 EC)

| Course code | Course name | EC |
|-------------|--------------------------|----|
| NWI-WM115C | Master Seminar | 6 |
| NWI-NM019B | Professional Preparation | 1 |

3. Philosophical component (3 EC)

| Course code | Course name | EC |
|--------------|---------------------------------------|----|
| NWI-WM040B | History and Philosophy of Mathematics | 3 |
| NWI-WM040C | History and Philosophy of Mathematics | 6 |
| NWI-FFIL300C | Philosophy of Mathematical Practice | 3 |

4. Free space for electives (6 EC)

5. Specialisation (60 EC)

The Science and Education specialisation includes the following components with the accompanying study load:

- Series of lectures (5 EC)
- Self-evaluation 1 (10 EC)
- Supervised internship (15 EC)
- Design and research (10 EC)
- Self-evaluation 2 (5 EC)
- Independent internship (15 EC)

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These components are provided by the Radboud Teachers Academy. If, due to the successful completion of the education minor during the Bachelor's programme or for other reasons, a portion of the above-mentioned components need not be followed, the corresponding number of EC must be filled with programme-specific components and/or components from the SiS or SMI programme as referred to in Articles 7.2b and 7.2c.

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PART IV FINAL PROVISIONS

Paragraph 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. Notwithstanding 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 to student interests.
3. In derogation from clause 1, the dean is authorised to drop elective components of the curriculum should the circumstances be deemed impossible to offer the course.

Article 9.3 Entry into force

These regulations enter into force on 1 September 2021.

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 30-06-2021.

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