Here is the translation of the text from German to English:

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Ordinance on the Master's Degree in Mathematics

Pursuant to Section 2(4) and Section 64(1) of the Higher Education Act of the State of North Rhine-Westphalia (Higher Education Act - HG) of September 16, 2014 (GV.NRW S. 547), as last amended by the Act of April 1, 2021 (GV. NRW. S. 329)

The University of Duisburg-Essen has issued the following ordinance:

I. General Provisions

§ 1. Scope of the Examination Regulations, Variants, and Module Handbooks

(1) These examination regulations apply to the Master's program in Mathematics at the University of Duisburg-Essen.

(2) The Master's program is also offered in an English variant under the name "Master of Mathematics".

(3) The examination regulations are supplemented by a module handbook. The module handbook must contain at least the information specified in the examination regulations as required. In addition, the module handbook contains detailed descriptions of the course content, the competences to be acquired, the prescribed examinations, and the teaching methods. The module handbook is published in electronic form by the Faculty of Mathematics.

§ 2. Admission Requirements, Ineligibility for Enrollment

(1) Admission to the Master's program in Mathematics requires proof of a first degree in a field of study with a minimum of 180 ECTS credits in Mathematics, Technomathematics, or Economic Mathematics at the University of Duisburg-Essen or a comparable degree from another domestic or foreign university.

(2) Deviating from paragraphs 1 and 2, admission to a Master's program may be granted if the examination committee determines that the applicant is qualified, in particular based on their average grade, and the applicant is not responsible for not meeting the admission requirements. Enrollment is terminated if the applicant fails to provide proof of meeting the admission requirements within six months of enrollment.

(3) Applicants who have not acquired their study qualification at a German-speaking institution are required to demonstrate sufficient German language proficiency in accordance with the Ordinance on the German Language Proficiency Test for University Admission of Foreign Students (DSH-Ordinance). In the English variant "Master of Mathematics", English language proficiency is assumed to be at least at level B2 of the Common European Framework of Reference for Languages (CEFR) based on a recognized language test (e.g., TOEFL, IELTS) or equivalent documentation. A German

language proficiency test is not required in this variant. A bachelor's or seminar paper written in English is also accepted as proof of English language proficiency.

(4) The Master's program can be taken in the first or higher semester, both in the winter and summer semesters.

(5) If an applicant has failed a required examination in a program with significant content overlap, admission to that program is excluded in accordance with Section 50 HG. The examination committee decides on the significant content overlap.

§ 3. Purpose of the Study Program, Purpose of the Examination

(1) The Master's program builds on a first degree and leads to a further academic degree. The program is designed for research-oriented or application-oriented specialization in the field of mathematics. It enables students to pursue a doctoral program.

(2) Upon successful completion of the examinations and the Master's thesis, students demonstrate that they have acquired the necessary subject-specific and interdisciplinary knowledge, skills, and methods to engage in independent scientific work, critically reflect on scientific findings, and act responsibly. The graduates are able to:

* define and interpret the specifics, limitations, terminology, and theoretical concepts of their field of study
* demonstrate a broad, detailed, and critical understanding of the latest knowledge in one or more specialized areas
* develop and apply their own ideas based on the acquired knowledge

They can:

* apply their knowledge and understanding, as well as their skills in problem-solving, even in new and unfamiliar situations related to their field of study
* make scientifically sound decisions based on incomplete or limited information, taking into account societal, scientific, and ethical aspects
* acquire new knowledge and skills independently
* conduct research or application-oriented projects independently or in a team
* communicate their findings and the underlying information and motivations clearly and concisely to experts and non-experts
* engage in scientific discussions with experts and non-experts
* take on significant responsibilities in a team

§ 4. Master's Degree

Upon successful completion of the Master's examination, the Faculty of Mathematics awards the academic degree of Master of Science (M.Sc.).

§ 5. Standard Period of Study, Part-time Study, Modularization, ECTS Credit System

(1) The standard period of study is four semesters.

(2) The study program is modularized. A module is a self-contained, thematically and temporally cohesive, and credit-bearing study unit that conveys a specific, precisely defined competence in relation to the overall goals of the study program.

(3) The workload required for a successful participation in a module is expressed in a certain number of credits. The credits include time for attendance, preparation and follow-up of lectures, examination workload, and examination preparation, including final and study papers, as well as internships, if applicable. The credits do not represent a qualitative evaluation of the modules (i.e., no grading).

(4) The University of Duisburg-Essen applies the European Credit Transfer System (ECTS). The Master's program has a total of 120 ECTS credits.

(5) On average, 30 ECTS credits are allocated to each semester. Over- and under-credits of up to 3 ECTS credits are permitted, provided they are offset in the following semester.

(6) One ECTS credit is assumed to require a workload of 30 hours of study and attendance per week, resulting in a total of 900 hours per semester. This corresponds to 39 hours per week over 46 weeks per year.

(7) The Master's program is designed to be completed within the standard period of study.

§ 6. Teaching and Learning Forms

(1) The following teaching and learning forms are possible in the Master's program:

a) Lecture
b) Exercise
c) Practical exercise
d) Language course
e) Seminar
f) Colloquium
g) Internship
h) External internship
i) Project
j) Excursion
k) E-learning/Blended learning
l) Tutoring
m) Self-study

Lectures provide a comprehensive presentation of fundamental and specialized knowledge, as well as methodological knowledge.

Exercises are primarily used to review and deepen the content and methods presented in other courses, using suitable examples.

Practical exercises have an application-oriented character and are used to practice and transfer selected knowledge and skills from the field of study in small groups.

Language courses are used to acquire and expand language skills, particularly oral and written communication skills in the respective foreign language.

Seminars provide the opportunity for active engagement with a scientific problem. Participation involves presenting one's own contribution to specific issues, engaging in controversial discussion, or interpreting and acquiring knowledge.

Colloquia are used for open, interdisciplinary scientific discussion. They aim to facilitate an open exchange of ideas.

Internships are used to explore relevant fields of work and to practice and deepen the skills acquired in the study program.

Projects are used to conduct empirical and theoretical work. They involve the planned and organized, independent processing of topic assignments, either individually or in a team (project team). The project team organizes the internal division of labor itself. The project work includes project planning, project organization, project implementation, and reflection of project progress in a plenum, as well as the presentation and discussion of project results.

Excursions illustrate aspects of the study program at suitable locations. Excursions enable direct contact with objects or persons and facilitate engagement with scientific questions. The findings are documented and evaluated.

E-learning/Blended learning combines traditional face-to-face teaching with online phases. This learning form combines various learning methods and media.

Tutoring is used to support students and student groups in their studies, particularly in guiding them to scientific work and deepening and supplementing the content of courses.

(2) The study plan (Appendix 1) may require regular attendance in the course as a prerequisite for module exams for excursions, language courses, internships, practical exercises, or comparable courses.

(3) Courses may be held entirely or partially in a foreign language.

§ 7. Admission Restrictions for Individual Courses

(1) Participation in individual courses may be restricted if, due to their nature and purpose or for other reasons from teaching and research, a limitation of the number of participants is necessary. The Dean or the Director of the Institute for Optional Studies decides on the admission restriction at the request of the lecturer.

(2) If the conditions of paragraph 1 are met and the number of applicants exceeds the capacity, the examination committee decides on admission at the request of the lecturer. In the case of courses offered by the Institute for Optional Studies, the Director decides.

(3) The faculties may restrict the right of students from other study programs to attend courses if, without such restriction, the proper education of students enrolled in the program cannot be guaranteed. This regulation also applies to second-year students in the sense of Section 52 HG.

(4) Exceptions may be granted to students in special situations (Section 22) and to students who are also taking a study assistantship.

(5) Admission to exams in courses with admission restrictions is subject to admission to the underlying course.

§ 8. Study Scope

(1) The Master's program consists of subject-specific compulsory and elective modules, as well as the Master's thesis.

(2) The credits are distributed as follows:

a) 30 credits are allocated to the Master's thesis.

b) 69-75 credits are allocated to the subject-specific modules in the 80:20 profile, and 90 credits in the 100:0 profile. In the English variant "Master of Mathematics", 90 credits are allocated.

c) 15-21 credits are allocated to the application subject in the 80:20 profile, and no credits in the 100:0 profile and in the English variant "Master of Mathematics".

(3) A credit account is established and maintained for each student in the examination office to document the completed performances.

§ 9. Examination Committee

(1) The examination committee is responsible for organizing examinations and the examination-related tasks arising from these examination regulations.

(2) The examination committee consists of the chairperson, the deputy chairperson, and five additional members. The chairperson, deputy chairperson, and two additional members are elected from the group of professors, one member from the group of academic staff, and two members from the group of students by the faculty council. The term of office of the members from the group of professors and academic staff is three years, and the term of office of the student members is one year. Re-election is permitted.

(3) The examination committee is a body in the sense of the Administrative Procedure and Administrative Court Procedure Act.

(4) The examination committee ensures that the provisions of the examination regulations are observed and ensures the proper conduct of examinations. It is responsible for deciding on appeals against decisions made in examination procedures.

(5) The examination committee provides recommendations for reforming the examination regulations and study plans.

(6) The examination committee may delegate the performance of its tasks for all routine cases (e.g., setting examination dates, appointing examiners and assessors, recognition procedures, disadvantage

compensation, and examination conditions for students in special situations) to the chairperson or deputy chairperson. This does not apply to decisions on appeals.

The chairperson may make decisions in urgent cases without the examination committee.

(7) The chairperson convenes the examination committee. The examination committee must be convened if requested by at least one member of the examination committee or a member of the dean's office of a participating faculty.

(8) The examination committee is quorate if, in addition to the chairperson or deputy chairperson, at least one additional member from the group of professors and at least one additional member with voting rights are present. It decides by simple majority. In the event of a tie, the chairperson's vote decides. The deputy members of the members may participate with a consultative vote in the meetings.

(9) The members of the examination committee have the right to attend the taking of examinations.

(10) The meetings of the examination committee are not public. The members of the examination committee and their deputy members are subject to the duty of confidentiality. If they are not public servants, they are sworn in by the chairperson of the examination committee to maintain confidentiality in accordance with the Law on the Formal Oath of Non-Officials (Verpflichtungsgesetz).

(11) The chairperson is supported by the examination office in the performance of their duties.

§ 10. Recognition of Performances, Placement in Higher Semesters

(1) Performances achieved in study programs at state or state-recognized universities, state or state-recognized colleges, or study programs at foreign state or state-recognized universities are recognized upon application, provided that there is no significant difference in the acquired competences compared to the performances to be replaced. Recognition in accordance with sentence 1 serves, regardless of Section 2(1), to continue the study program and to take examinations.

(2) Equivalence agreements and agreements between the Federal Republic of Germany and other states on equivalences in the higher education sector, which benefit students from foreign states deviating from sentence 1, take precedence over the regulations of sentence 1.

(3) The applicant is responsible for providing the necessary information about the performance to be recognized. The documents must contain statements about the acquired competences in the case of sentence 1 and about the content and level of the performances to be recognized in the case of sentence 2. The documents are to be submitted to the examination office.

(4) The examination committee is responsible for recognition in accordance with sentences 1 and 2 and for conducting the placement examination in accordance with sentence 7.

(5) If performances are recognized, the grades are transferred and the credits allocated in accordance with the examination regulations. The recognized grades are included in the calculation of the module grades and the overall grade.

(6) If the examination committee rejects an application for recognition, the students are informed in writing with a reasoned decision and a statement of appeal.

(7) Students who have passed a placement examination in accordance with Section 49(12) HG are entitled to have their acquired knowledge and skills recognized in the examination procedures.

§ 11. Examiners, Assessors

(1) Examiners and assessors may only be appointed from the group of professors, associate professors, lecturers, private lecturers, and scientific staff who have completed the corresponding Master's examination or a comparable examination and have teaching experience.

(2) The examination committee appoints the examiners and assessors. The appointment of assessors may be delegated to the examiners.

(3) Examiners are independent in their examination activities. They are responsible for the content and conduct of the examinations. They inform the students about the permitted aids for the examination.

(4) Students may propose a first examiner for their Master's thesis. The proposal is taken into account as far as possible.

II. Master's Examination

§ 12. Admission to Examinations

(1) Admission to examinations is only granted to students who are enrolled in the Master's program at the University of Duisburg-Essen and have not been suspended.

(2) Admission to examinations is refused if:

a) the admission requirements of paragraph 1 are not met,

b) the student has already failed a required examination in the same or a similar program at a university in the Federal Republic of Germany,

c) the student is currently enrolled in an examination procedure in the same or a similar program at a university in the Federal Republic of Germany.

(3) This regulation applies to all module exams.

§ 13. Structure of the Examination, Form of Module Exams

(1) The Master's examination consists of module exams and the Master's thesis.

(2) Module exams are designed to assess the competences acquired in the module. In the module exams, students demonstrate that they have acquired the module's content and methods and can apply the acquired competences.

(3) Module exams are taken during the study program and conclude the respective module. Credits are awarded for successful completion of each module exam.

(4) Module exams are graded.

(5) Module exams may take the following forms:

a) oral exam,

b) written or electronic exam (Klausurarbeit),

c) written or electronic exam (Hausarbeit or Protokoll),

d) oral presentation or report,

e) portfolio exam,

f) experimental work,

g) other exam forms (as determined by these examination regulations),

h) a combination of the above exam forms.

(6) The specific exam forms for modules are regulated in these examination regulations. The concrete exam requirements are described in the module handbook. Students are informed about the exam form and duration at the beginning of the course.

(7) In addition to module exams, students may be required to submit study performances. Study performances serve to control the students' learning progress. They may be used as a prerequisite for module exams. The study performances are described in the module handbook. The regulation on registration for and repetition of exams does not apply to study performances. The evaluation of study performances is not taken into account in the calculation of module grades.

§ 14. Registration and Withdrawal from Exams, Announcement of Exam Results

(1) A study-performance-based exam, as specified in Sections 15 and 16, is offered at the latest during the semester break after the end of the respective course. The exam dates are set so that no courses fall through due to the scheduling. The dates are announced by the examination committee or the management of the institution organizing the exam at least six weeks before the exam date.

(2) Students are required to inform themselves about the exam dates.

(3) Students must register for all written exams and oral exams within the registration period in the fifth and sixth weeks of the semester in the university's online portal (deadline). The registration period for other exams is determined by the examination committee.

(4) Withdrawal from an exam must be made by the student at the latest one week before the exam date (deadline). Withdrawal from an exam is no longer possible after the exam topic has been announced.

(5) All exam results are announced to the students immediately after evaluation by entry in the electronic examination database or in another suitable form. Students receive an email with the entry in the database at the email address assigned by the university. If the entry is made in the electronic

examination database, the exam result is considered announced two weeks after entry in the database. Section 15(5) remains unaffected.

§ 15. Oral Exams

(1) In an oral exam, the student demonstrates that they have a good understanding of the subject matter and can apply their knowledge to specific questions.

(2) Oral exams are usually held in the presence of at least one examiner and one assessor. Before the final grade is awarded, the assessor is heard. Oral exams that conclude a study program or for which there is no opportunity for re-examination are evaluated by two examiners.

(3) In a group oral exam, no more than four students may be examined at the same time. In a group oral exam, the individual contribution of each group member must be clearly recognizable, distinct, and evaluable.

(4) Oral exams last at least 20 minutes and no more than 45 minutes per student. In exceptional cases, the time limit may be deviated from.

(5) The essential points and the result of the oral exam are recorded in a protocol. The exam result is announced to the student immediately after the oral exam. The protocol and the exam result are submitted to the examination office in writing.

(6) Students who wish to take the same oral exam at a later date may be admitted as observers, unless the student taking the exam objects. The examiner decides on the application, taking into account the available places. Admission as an observer does not entitle the student to participate in the discussion or to receive the exam result.

§ 16. Written Exams

(1) In a written exam, the student demonstrates that they can solve problems from the subject matter within a limited time and with the permitted aids.

(2) Written exams may be held in the form of a software-based exam (E-Prüfung). The students are informed about the E-Prüfung format. They are given the opportunity to familiarize themselves with the exam conditions and the exam system.

(3) Written exams have a duration of 30 minutes to 180 minutes.

(4) Written exams that conclude a study program or for which there is no opportunity for re-examination are evaluated by at least two examiners.

(5) Each written exam is evaluated according to the evaluation scheme in Section 24. The grade is determined by the arithmetic mean of the individual evaluations in accordance with Section 24(2). The grade of written exams in the multiple-choice format is determined by the examiner.

(6) The evaluation process is usually completed within six weeks. The evaluation of a written exam is submitted to the examination office in writing immediately after completion of the evaluation process.

§ 17. Other Exam Forms

The general provisions for written exams, oral exams, and other exam forms are specified by the examination committee. For written exams, the provisions of Sections 14 and 16(4) to (6) apply accordingly. The specific provisions for oral exams, written exams, and other exam forms are determined by the examiner. Section 65(2) HG remains unaffected. In group exams, Section 15(3) applies, and in group work, Sections 18(7) and (10) apply accordingly.

§ 18. Master's Thesis

(1) The Master's thesis is a performance-based exam that usually concludes the study program. The Master's thesis demonstrates that the student can work independently and apply scientific methods to a specific problem within a given time frame.

(2) Admission to the Master's thesis is only granted to students who have completed 72 ECTS credits. The examination committee decides on exceptions.

(3) Students register for the Master's thesis in the examination office. The topic of the Master's thesis is assigned by the examiner or the examination committee. The assignment of the topic and the deadline are announced in the examination office.

(4) The topic of the Master's thesis is assigned by a professor, associate professor, or private lecturer from the relevant faculty. The topic is usually assigned by the examiner who teaches the course. Students have the right to propose a topic for their Master's thesis.

(5) The Master's thesis is to be completed within the specified time frame. The time frame is 26 weeks. In exceptional cases, the examination committee may extend the time frame by up to six weeks on written application. The application must be submitted to the chairperson of the examination committee immediately after the obstacle arises.

(6) The topic, the assignment, and the scope of the Master's thesis must be such that the specified time frame can be met.

(7) The Master's thesis may be taken in the form of a group work, provided that the individual contribution of each student can be clearly identified and evaluated.

(8) The Master's thesis is to be written in German, English, or another language accepted by the examination committee. The Master's thesis must be submitted in triplicate in printed and bound form in DIN A4 format and in electronic form.

(9) The Master's thesis should have a length of 20 to 120 pages. Necessary detailed results may be included in an appendix.

(10) When submitting the Master's thesis, the student must declare in writing that they have written the thesis independently and without unauthorized assistance, and that they have used only the sources and aids listed.

(11) The deadline for submitting the Master's thesis is announced in the examination office. If the Master's thesis is not submitted on time, it is considered to have been graded as "not sufficient" (5.0).

(12) The Master's thesis is evaluated by two examiners. The evaluation is written and must be justified.

(13) The individual evaluation is made according to the evaluation scheme in Section 24. The grade of the Master's thesis is determined by the arithmetic mean of the individual evaluations, provided that the difference is not more than 2.0. If the difference is more than 2.0 or if only one evaluation is better than "not sufficient" (5.0), a third examiner is appointed by the examination committee. In this case, the grade is determined by the arithmetic mean of the two better evaluations. The Master's thesis can only be graded as "sufficient" (4.0) or better if at least two evaluations are "sufficient" (4.0) or better.

(14) The evaluation process is usually completed within six weeks. The evaluation of the Master's thesis is submitted to the examination office in writing immediately after completion of the evaluation process.

§ 19. Re-examination

(1) Successful completion of study-performance-based exams and a successful Master's thesis cannot be repeated.

(2) Failed or failed exams can be repeated twice.

(3) The examination committee ensures that each study-performance-based exam is offered at least twice within two consecutive semesters. At least four weeks must elapse between the first exam and the re-exam. The results of the previous exam must be available to the examination office at least seven days before the re-exam.

(4) A re-exam is evaluated by two examiners. The evaluation is written and must be justified.

(5) A failed Master's thesis can be repeated once. However, the topic of the second Master's thesis can only be returned within the specified time frame if the student has not used this option for the first Master's thesis.

§ 20. Repeat Exam

A repeat exam is not provided for in the Master's program.

§ 21. Failure to Appear, Withdrawal, Cheating, Disorderly Conduct

(1) An exam is graded as "not sufficient" (5.0) if the student:

* fails to appear for a scheduled exam without a valid reason, or
* withdraws from an exam without a valid reason after it has begun, or
* fails to complete a written exam within the specified time frame.

(2) A valid reason for failure to appear or withdrawal includes illness or a special situation in the sense of Section 22(3) and (4).

(3) The student must notify the examination office in writing and justify their reason for failure to appear or withdrawal within three working days after the exam date (Saturdays are not working days).

If the student is ill, a medical certificate must be submitted, stating the duration of the illness. The illness of the student is considered equivalent to the illness of a child or a dependent relative in the sense of Section 22(4). If the reason for failure to appear or withdrawal is recognized, the exam attempt is not counted.

(4) If the student attempts to influence the result of their performance by cheating or using unauthorized aids, the exam is graded as "not sufficient" (5.0). The examiner or the examination committee determines the cheating and documents it. In severe cases, the student may be barred from re-exams.

(5) A student who disrupts the orderly conduct of an exam may be excluded from further participation in the exam by the examiner or the examination committee. In this case, the exam is graded as "not sufficient" (5.0).

(6) The examination committee may require the student to provide a written declaration that the performance was completed independently and without unauthorized assistance. Cheating is considered an administrative offense. The offense may be punished with a fine of up to €50,000. The competent administrative authority for the prosecution and punishment of administrative offenses is the Chancellor.

§ 22. Disadvantage Compensation, Students in Special Situations

(1) The special needs of students with disabilities and chronic illnesses are taken into account to ensure equal opportunities. If the student provides a suitable document, such as a medical certificate, demonstrating that they are unable to participate in an exam due to a long-term or permanent disability or chronic illness, the chairperson of the examination committee may grant the student an alternative form of performance or a longer time frame.

(2) The special needs of students with disabilities and chronic illnesses are also taken into account for the submission of study performances. The examination committee determines the alternative form of performance or time frame on a case-by-case basis.

(3) For students who are entitled to protection under the Maternity Protection Act, the examination committee determines the exam conditions, including the time frame, on a case-by-case basis.

(4) For students who are caring for children, the examination committee determines the exam conditions, including the time frame, on a case-by-case basis.

§ 23. Passing and Failing the Master's Examination

(1) The Master's examination is considered passed if the student has successfully completed all module exams and the Master's thesis in accordance with these examination regulations and has acquired the required credits.

(2) The Master's examination is considered failed if:

* a required performance is not successfully completed, and
* there is no opportunity for re-examination.

(3) If the Master's examination is considered failed, the examination committee issues a certificate stating the successfully completed performances, their grades, and the acquired credits, and indicating that the Master's examination has been failed.

§ 24. Evaluation of Performances and Calculation of Grades

(1) The following grades are assigned by the examiners for the evaluation of individual performances:

1.0 or 1.3 = excellent (outstanding performance)

1.7 or 2.0 or 2.3 = good (performance significantly above average)

2.7 or 3.0 or 3.3 = satisfactory (performance meets average requirements)

3.7 or 4.0 = sufficient (performance meets requirements despite defects)

5.0 = not sufficient (performance fails to meet requirements due to significant defects)

(2) If a performance is evaluated by multiple examiners, the grade is the arithmetic mean of the individual grades. Only the first decimal place is taken into account; all further places are truncated without rounding. The grade is:

* excellent (1.0 or 1.3) if the average is up to 1.5
* good (1.6 to 2.5) if the average is between 1.6 and 2.5
* satisfactory (2.6 to 3.5) if the average is between 2.6 and 3.5
* sufficient (3.6 to 4.0) if the average is between 3.6 and 4.0
* not sufficient (4.1 or higher) if the average is 4.1 or higher

(3) A performance is considered passed if it is graded as "sufficient" (4.0) or better. A performance is considered failed if it is graded as "not sufficient" (5.0) and all opportunities for re-examination have been exhausted.

§ 25. Module Grades

(1) A module is considered passed if all performances associated with the module have been completed and graded as "sufficient" (4.0) or better.

(2) If a module exam consists of a single performance, the grade of the performance is also the grade of the module exam.

(3) If a module exam consists of multiple performances, the grade of the module exam is the weighted mean of the grades for the individual performances. The weighted mean is calculated by dividing the sum of the grades multiplied by the credits by the total number of credits for the module. Section 24(2) applies accordingly.

§ 26. Calculation of Overall Grade

(1) The overall grade is calculated as the weighted arithmetic mean of:

* the module grades, and
* the grade of the Master's thesis.

Ungraded performances (e.g., internships, performances recognized without a grade) are not taken into account in the calculation of the overall grade.

(2) Only the first decimal place is taken into account; all further places are truncated without rounding. Section 24 applies accordingly.

(3) If the Master's thesis is graded as 1.0 and the overall grade is 1.3 or better, the overall grade is considered "with distinction" in the certificate.

§ 27. Additional Exams

(1) Students may take additional exams, subject to availability, in subjects beyond the compulsory and elective modules.

(2) The result of an additional exam is not taken into account in the calculation of the module grades and overall grade.

§ 28. Certificate and Diploma Supplement

(1) Upon successful completion of the Master's examination, students receive a certificate in German. The certificate contains the following information:

* Name of the university and faculty,
* Name, first name, date of birth, place of birth, and country of birth of the student,
* Name of the study program,
* Names and grades of the completed modules with the acquired credits,
* Title and grade of the Master's thesis with the acquired credits,
* Overall grade with the total acquired credits,
* On request, the required duration of the study program,
* On request, the results of any additional exams taken,
* Date of the last exam,
* Signatures of the chairperson of the examination committee and the Dean of the faculty,
* University seal.

A transcript of records may be created as an annex to the certificate. The transcript of records contains all exams, including the grades.

(2) Upon completion of the Master's program, students receive a Diploma Supplement in German. The Diploma Supplement contains:

* Personal data (as in the certificate),
* General information on the type of degree,
* Information on the university awarding the degree,
* Information on the study program, study progression, and acquired competences, as well as information on the performances, evaluation system, and credit system.

The Diploma Supplement is accompanied by an evaluation of the overall grade in accordance with ECTS, indicating the percentage of students in the faculty who completed the Master's program with an overall grade of "excellent", "good", "satisfactory", or "sufficient" in the last four completed semesters.

(3) The Diploma Supplement bears the same date as the certificate.

§ 29. Master's Diploma

(1) Upon successful completion of the Master's examination, students receive a Master's diploma. The diploma indicates the awarded Master's degree and bears the date of the certificate.

(2) The diploma is signed by the chairperson of the examination committee and the Dean of the faculty, and is sealed with the university's seal.

(3) Section 28(3) applies accordingly.

III. Final Provisions

§ 30. Invalidity of the Master's Examination, Revocation of the Master's Degree

(1) If a student has cheated in an exam and this is discovered after the certificate has been issued, the examination committee may retroactively correct the grades for the performances in which cheating occurred and declare the exam failed.

(2) If the admission requirements for an exam were not met, without the student intending to cheat, and this is discovered after the certificate has been issued, the deficiency is considered healed by passing the exam. If the admission was obtained intentionally, the examination committee decides on the consequences in accordance with the Administrative Procedure Act for the State of North Rhine-Westphalia.

(3) The student is given the opportunity to comment before a decision is made.

(4) All incorrect certificates are withdrawn and replaced with new certificates, if necessary. A decision under paragraph 1 or paragraph 2, sentence 2, is excluded after a period of five years from the date of degree award.

(5) If the exam is declared failed overall, the awarded degree is revoked and the diploma is withdrawn.

§ 31. Access to Exam Papers

(1) Students are granted access to their written exam papers upon request after individual exams. The request must be made within one month of the announcement of the exam result. The examination committee determines the further procedure.

(2) Examination decisions are isolated and can be appealed.

§ 32. Maintenance of Exam Records, Storage Periods

(1) Exam records are maintained electronically.

a) The following data are stored electronically:

* Name, first name, matriculation number, date of birth, place of birth, and country of birth
* Study program
* Study start date
* Exam performances
* Registration and withdrawal dates, exam withdrawals
* Date of study completion
* Date of certificate issuance

b) The following documents are maintained in paper form:

* Master's thesis
* Certificate
* Diploma
* Exam papers
* Exam protocols
* Appeals and applications for recognition
* Certificates and recognition applications

(2) The storage and, in particular, the storage periods are determined by the applicable storage regulations.

(3) The storage of the records maintained in accordance with paragraph 2 is the responsibility of the examination office.

§ 33. Entry into Force and Publication

This examination regulation enters into force on the day following its publication in the Official Gazette of the University of Duisburg-Essen.

At the same time, the examination regulation for the Master's program in Mathematics of May 9, 2014 (Official Gazette, Vol. 12, 2014, p. 583/No. 52), as last amended by the third amendment regulation of February 13, 2019 (Official Gazette, Vol. 17, 2019, p. 39/No. 15), is repealed; Section 33(2) remains unaffected.

This regulation was adopted by the Faculty Council of the Faculty of Mathematics on April 25, 2018, January 16, 2019, June 5, 2019, and April 9, 2025.

Note:

It is pointed out that the violation of procedural or formal provisions of the Higher Education Act or the autonomous law of the university cannot be invoked after a period of one year from the date of publication, unless:

1. The regulation was not properly published,
2. The rectorate objected to the decision of the governing body that adopted the regulation,

3. The procedural or formal defect was previously raised against the university, and the violated provision and the fact that constitutes the defect were specified,
4. The public announcement of the regulation did not mention the consequence of the objection.

Duisburg and Essen, [Date]

For the Rector of the University of Duisburg-Essen

The ellor
Ulf Richter

Appendix 1: Study Plan

1. The module offer of the Master's program in Mathematics is divided into the following areas:

* Broadening area
* Expanding area, divided into the following focal points:

Algebra
Analysis
Numerical Mathematics
Optimization
Stochastics

* Deepening area, divided into the above-mentioned focal points
* Seminar area, divided into the above-mentioned focal points
* Master's thesis

2. The English variant "Master of Mathematics" can only be taken in the 100:0 profile.

3. In the 100:0 profile, 0 to 9 credits are allocated to the broadening area, up to 45 credits to the expanding area, at least 18 credits to the deepening area, and between 18 and 45 credits to the seminar area. 30 credits are allocated to the Master's thesis. No credits are allocated to the application subject.

4. The Master's thesis is written in one of the five focal points mentioned in paragraph 1 (see expanding area). In this focal point, at least 27 credits must be acquired through modules in the expanding, deepening, and seminar areas. At least 18 credits must be acquired from these areas in another focal point.

A list of all studyable modules can be found in the following table. Detailed information on the application subjects can be found in Appendix 2.

Hier ist die Übersetzung des Textes ins Englische:

Contents and Qualification Goals of the Modules

Expansion Area

Module: Mathematical Retrospectives

By choosing a lecture from one of the modules of the advanced area of the Bachelor's degree in Mathematics, students expand their knowledge gained in the Bachelor's program by basic knowledge from areas not considered in the Bachelor's program and can relate this knowledge to the specializations chosen in the Master's program.

Expansion Area Focus: Algebra

Module: Algebraic Geometry I

Students learn algebraic methods useful in geometry. They should be able to penetrate complex proofs and learn about the interplay between geometry and algebra. Students learn geometric questions and the importance of sheaves and cohomology theory for their treatment.

Module: Algebraic Topology I

Students learn the basic concepts of algebraic topology and gain experience with the theory of classification of objects. They should be able to perform calculations of (co-)homology groups.

Module: Algebraic Number Theory II

Students learn advanced methods useful in modern number theory. They should learn about the importance of local fields and cohomology theory for the solution of arithmetic problems.

Module: Analytic Number Theory I

Students learn methods of analytic number theory, which allows the connection between number theory and analysis. They penetrate complex proofs and learn through exercise problems classical applications.

Module: Complex Geometry I

An introduction to the theory of complex manifolds is given. Students should learn to formalize their perception in analytical and algebraic questions, solve questions with the presented methods, and interpret the results obtained.

Module: Modular Forms I

Through the treatment of modular forms, a systematic deepening and expansion of the knowledge and skills acquired in the Bachelor's program is achieved. Students learn complex mathematical methods and techniques.

Module: Riemannian Surfaces I

The concept of Riemannian surfaces allows a combination of perception and theory. Students should learn to formalize their perception in analytical questions, solve questions with the presented methods, and interpret the results obtained.

Analysis Focus

Module: Differential Geometry I

Students learn about the curvature properties of geometric objects and their deeper properties. They should be able to penetrate complex proofs and gain insight into the interplay of various mathematical disciplines (e.g. analysis-geometry-topology).

Module: Differentiable Manifolds

Students learn about the concept of differentiable manifolds and basic concepts of analysis, geometry, and topology of these objects. They penetrate complex proofs and are able to apply the theory to exercise problems.

Module: One-Dimensional Variational Calculus

The basic concepts and important proof techniques of variational calculus in one dimension are presented. In addition to classical methods, modern "direct methods" are also treated.

Module: Functional Analysis II

Students learn advanced functional analytical concepts and methods and can apply them particularly to linear partial differential equations. They build their skills in interpreting and applying the results obtained from abstract theory to concrete application problems.

Module: Minimal Surfaces

Students acquire knowledge about the basic concepts and methods of minimal surface theory and their geometric significance. They are able to apply this knowledge in exercise problems.

Module: Riemannian Geometry I

Students learn how to use essential concepts of Riemannian geometry to formalize geometric concepts and make them accessible for calculations. They develop a perception of geometric spaces and learn to use suitable concepts for given geometric questions.

Module: Variational Calculus I

Students learn about the techniques of underestimation for the construction of solutions to certain variational problems. In addition, suitable spaces are explained, which are also important beyond variational calculus and have multiple applications in analysis.

Numerical Focus

Module: Mixed Finite Element Methods

Students learn the concept of mixed finite element methods at the example of selected partial differential equations. They develop a comprehensive understanding of the theoretical foundations and numerical methods and their application areas.

Module: Numerics of Evolution Equations

Numerical methods for the solution of evolution equations are treated. Students develop a comprehensive understanding of the theoretical foundations and numerical methods and their application areas.

Optimization Focus

Module: Mathematical Image Processing

Students learn modern variational methods for image processing and reconstruction tasks. They learn modern methods for numerical solution and practical implementation, for example in biomedical imaging.

Module: Stochastic Optimization

Students learn special knowledge about the theory and algorithmics of optimization under uncertainty. They learn modeling techniques and approaches to software implementation and acquire deeper knowledge in a field of optimization at the interface to stochasticity and measure theory.

Module: Variational Calculus and Optimal Control of Ordinary Differential Equations

The goal is to convey basic knowledge and skills in the field of variational calculus and optimal control of ordinary differential equations. These skills are deepened and solidified in exercises with elementary examples. Simple examples from mechanics are discussed to demonstrate the applicability of the learned knowledge.

Stochastic Focus

Module: Probability Theory II

Students learn the basics of the theory of stochastic processes. In particular, they should learn about Markov processes and martingales as important process classes. At the example of the Brownian motion, they should learn to apply important proof techniques independently.

Depth Area Focus: Algebra

Module: Algebraic Geometry II

Students learn algebraic methods useful in geometry. They learn geometric questions and the importance of sheaves, cohomology theory, and functors for their treatment.

Module: Complex Geometry II

In this module, the theory of complex manifolds is further developed. The interplay of algebraic, topological, and analytical methods for the description of compact complex manifolds is in the center of the considerations.

Module: Riemannian Surfaces II

Students are further introduced to the theory of Riemannian surfaces. They learn about the interplay of algebraic, topological, and analytical methods for the description of compact complex manifolds.

Module: Selected Topics in Algebraic Geometry

In this module, students are introduced to current research in the field of algebraic geometry. They learn advanced proof techniques and are able to apply the learned theory in various contexts.

Module: Selected Topics in Complex Geometry

In this module, students are introduced to current research in the field of complex geometry. They learn advanced proof techniques and are able to apply the learned theory in various contexts.

Module: Selected Topics in Number Theory

In this module, students are introduced to current research in the field of number theory. They learn advanced proof techniques and are able to apply the learned theory in various contexts.

Analysis Focus

Module: Analysis of Variational Inequalities

Students learn the direct method of variational calculus and the method of monotone operators for solving nonlinear partial differential equations and can apply them to examples.

Module: Evolution Equations

Students learn advanced, abstract, functional analytical concepts and methods for the investigation of initial value problems for nonlinear partial differential equations. They are able to apply the results obtained from abstract theory to relevant problems in practice.

Module: Nonlinear Functional Analysis

Students gain deeper insights into the infinite-dimensional analysis with nonlinear operators. The focus is on learning and mastering functional analytical methods for solving nonlinear partial differential equations, which arise from modeling problems from applications.

Module: Selected Topics in Analysis

Students acquire deeper knowledge in various areas of analysis and are introduced to current research. They understand complex proofs, can apply the learned methods in new contexts, and have a sovereign handling of concepts, methods, and results from the field of analysis.

Numerical Focus

Module: Multigrid and Domain Decomposition Methods

Students acquire a comprehensive understanding of the basic principles and functions of multigrid and domain decomposition methods and are able to implement them algorithmically. They have a comprehensive understanding of the theoretical foundations and convergence analysis of the considered methods.

Module: Numerical Methods for Variational Inequalities

In this module, the mathematical and numerical analysis of variational inequalities with applications in mechanics and engineering is treated. Students acquire a comprehensive understanding of the theoretical foundations and numerical methods and are able to implement them algorithmically.

Module: Theory and Numerics of Geometric Partial Differential Equations

Students are introduced to the theory of geometric partial differential equations and examples are shown that facilitate the entry into this field. They learn advanced proof techniques of numerical mathematics and are able to develop and test numerical methods on the computer.

Module: Selected Topics in Numerical Mathematics

In this module, students are introduced to current research topics in the field of numerical mathematics. They are familiar with typical questions of the theory, learn advanced proof techniques, and are able to apply the learned theory in various contexts.

Optimization Focus

Module: Industrial Applications of Mathematical Optimization

Students gain insights into mathematical methods for the production, transport, and trade of pipeline-bound energy carriers. They are able to introduce new mathematical methods into modeling and develop and implement adapted solution procedures software-technically.

Module: Nonsmooth Analysis and Optimization

Students master basic techniques of variational calculus for proving the existence of solutions to infinite-dimensional optimization problems and nonsmooth analysis for deriving necessary optimality conditions for nondifferentiable optimization problems. They are familiar with modern methods and can apply them to problems from practice.

Module: Numerics and Optimization of Large Nonlinear Systems

Students acquire knowledge about modern methods for large nonlinear systems and optimization tasks. Special attention is paid to the globalization of locally fast convergent methods. In addition, basic knowledge in the analysis of nonlinear tasks is imparted.

Module: Numerical Analysis for Optimal Control Problems

In this module, comprehensive knowledge about optimality conditions for discretized and nondiscretized optimal control problems is imparted. Various approaches and methods for the

discretization of such problems are discussed. The focus is on how to derive error estimates for FEM based on optimality conditions.

Module: Optimal Control of Partial Differential Equations

In this module, basic knowledge in the optimal control of partial differential equations is imparted. Students learn methods for deriving optimality conditions and existence results and gain an overview of various numerical approaches for solving optimal control problems.

Module: Selected Topics in Inverse Problems

Students acquire deeper knowledge in various areas of inverse problems and are introduced to current research. They are familiar with typical questions of the theory, understand complex proofs, and are able to apply the learned methods in new contexts.

Module: Selected Topics in Optimization

Students acquire deeper knowledge in various areas of optimization and are introduced to current research. They are familiar with typical questions of the theory, understand complex proofs, and are able to apply the learned methods in new contexts.

Stochastic Focus

Module: Aspects of Risk Management

Students can translate basic aspects of risk assessment into a suitable stochastic modeling. They are familiar with important stochastic concepts for modeling and know corresponding methods for processing such tasks.

Module: Machine Learning

Students are introduced to representative models, methods, and algorithms from the field of machine learning. They learn additional applications in modeling, forecasting, and control of multimodal information systems.

Module: Numerics of Stochastic Processes

Students acquire basic knowledge about the simulation of random numbers and stochastic processes. They learn efficient methods for calculating financially relevant quantities and are introduced to a current scientific field.

Module: Theory of Large Deviations

In this module, students gain insights into the partially abstract theory of large deviations and are shown examples that illustrate the contribution of this theory to specific models. The acquired knowledge is to be deepened in the accompanying exercises independently.

Module: Time Series Analysis

Students learn to set up time series models independently and are able to estimate the chosen models using suitable software and make predictions based on them. They should acquire the ability to discover properties of time series and then use the appropriate analytical instrument.

Module: Time-Continuous Financial Mathematics

In this module, the basic concepts and theorems of analysis in continuous time are presented. The focus is on the martingale theory and stochastic integration. Students learn how to use this theory for modeling financial mathematical questions.

Module: Selected Topics in Stochastic Analysis

Students acquire deeper knowledge in the field of stochastic analysis and are introduced to current research. They are familiar with typical questions of the theory, understand complex proofs, and are able to apply the learned methods in new contexts.

Module: Selected Topics in Stochastic Processes

Students acquire deeper knowledge in the field of stochastic processes and are introduced to current research. They are familiar with typical questions of the theory, understand complex proofs, and are able to apply the learned methods in new contexts.

Seminar Area

Module: Master Seminar Algebra

Students demonstrate that they can work on a limited, challenging topic from the field of algebra with higher actuality, prepare and hold a presentation, and answer related questions. A higher level of independence in the processing is expected, as well as a written report.

Analysis Focus

Module: Master Seminar Analysis

Students demonstrate that they can work on a limited, challenging topic from the field of analysis with higher actuality, prepare and hold a presentation, and answer related questions. A higher level of independence in the processing is expected, as well as a written report.

Numerical Focus

Module: Master Seminar Numerical Mathematics

Students demonstrate that they can work on a limited, challenging topic from the field of numerical mathematics with higher actuality, prepare and hold a presentation, and answer related questions. A higher level of independence in the processing is expected, as well as a written report.

Optimization Focus

Module: Master Seminar Optimization

Students demonstrate that they can work on a limited, challenging topic from the field of optimization with higher actuality, prepare and hold a presentation, and answer related questions. A higher level of independence in the processing is expected, as well as a written report.

Stochastic Focus

Module: Master Seminar Stochastics

Students demonstrate that they can work on a limited, challenging topic from the field of stochastics with higher actuality, prepare and hold a presentation, and answer related questions. A higher level of independence in the processing is expected, as well as a written report.

Master's Thesis

Module: Master's Thesis

The Master's thesis concludes the scientific education in the Master's program. Over a period of six months, students work independently under scientific guidance on a topic that is related to the latest research results of the chosen focus area. Through the expected higher level of independence, students demonstrate their ability to work scientifically and support the scientific further development of the field.