

Examination Regulations
for the International Master's Programme
Scientific Computing
in the framework of the Elite Network Bavaria (ENB) at
the University of Bayreuth
dated 7 June 2019
as amended on 20 November 2019

Article 13 para 1 sentence 2 in conjunction with Article 61 para 2 sentence 1 and Article 61 para 2 sentence 1 of the Bavarian Higher Education Act (*BayHSchG*) forms the basis for the following examination regulations issued by the University of Bayreuth.

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*The University of Bayreuth is not liable for inaccuracies or mistakes in this English translation.
In case of doubt, the German originals are to be used in a court of law.*

§ 1

Purpose of the master's examination

1The interdisciplinary approach of this elite English-taught programme allows students to acquire and apply specialized knowledge in numerical methods for solving differential and integral equations and in data analysis, while broadening their horizons to other subject areas.

2A doctorate within the framework of a fast-track option is possible. The master's examination, carried out over the course of the master's programme Scientific Computing, is used to determine whether the candidate has acquired the expertise stipulated in the present regulations and has the following competencies:

- the ability to think abstractly,
- precision in analytical thinking,
- valid argumentation,
- the proven ability to structure complex interrelationships,
- a high level of perseverance in solving difficult problems,
- broad insights into interdisciplinary interrelationships,
- the proven ability to implement mathematical methods for complex scientific-technical problems and to implement them professionally on modern computer systems,
- the ability to carry out advanced independent scientific work,
- the ability to function as a responsible mathematician in interdisciplinary teams of mathematicians, computer scientists, natural scientists, engineers, and economists in business and industry.

4Upon the candidate's passing of the master's examination, the University of Bayreuth, by way of the Faculty of Mathematics, Physics & Computer Science, awards the academic degree "Master of Science" (abbreviated as *M.Sc.*).

§ 2

General Examination and Study Regulations

The proper implementation of all examinations addressed in the present regulations is governed by the applicable General Examination and Study Regulations for Bachelor's and Master's Programmes in Mathematics at the University of Bayreuth (General Examination and Study Regulations).

§ 3

Board of examiners

Notwithstanding § 2 para 1 sentence 4 of the General Examination and Study Regulations, the board of examiners shall be elected by the faculty council of the Faculty of Mathematics, Physics and Computer Science from among the university instructors participating in the elite study programme.

§ 4

Structure of the programme and the master's examination; standard period of study

(1) The master's programme Scientific Computing is divided into modules and is made up of the following areas:

a) Module area A: "Numerical Mathematics"

In this module area, the foundations of the field of numerics are to be laid for the degree programme.

A1: Module "Numerical Methods for Differential Equations"

If the contents of module A1 were already acquired in the bachelor's programme, a module comprising eight credit points is to be selected from the elective modules A2 as an alternative to A1. In this case, a total of 8 to 16 credit points can be earned in module area A.

A2: Elective modules "Advanced Topics in Numerical Mathematics"

Further modules shall be completed with a maximum of 16 credit points from the modules listed in Annex 1.

b) Module area B: "Modeling and Simulation"

The assessment components include the study of scientific-technical or statistical fields of application whose mathematical modelling leads to problems that are interesting for scientific computing due to their complexity. At the same time, areas of applied mathematics are to be studied that form the basis for modelling:

B1: Module "Applied Functional Analysis"

If the contents of module A1 were already acquired in the bachelor's programme, a module comprising 8 credit points is to be selected from the elective modules B2 as an alternative to B1.

B2: Core elective module "Modeling and Simulation"

Additional modules shall be completed in the amount of 8 to 16 credit points from the modules listed in Annex 1. Modules must include at least 8 credit points from the non-mathematical courses offered. On request, the board of examiners may admit modules from other fields of application provided that they meet the requirements given above. Furthermore, the board of examiners may also approve introductory modules from the relevant field of application if these are required for successful participation in a module.

B3: Module "Industrial Internship"

In order to apply the learned methods and to receive impulses for their own research, the students complete an industrial internship of at least 6 weeks. As a rule, industrial internships are to be organized by the student and integrated into the programme within the standard period of study. Students can obtain help in organizing the industrial internship from the scientists involved in the elite degree programme. A report of at least 10 pages must be submitted within 4 weeks of completing the internship. The internship is assessed as "passed" or "failed". As an alternative to the industrial internship, students can successfully complete additional modules amounting to 8 credit points from the core elective modules D1 of Annex 1.

B4: Module "Modeling and Status Seminar"

The module comprises the annual modelling week and the annual status seminar of the programme. Students are obligated to actively participate in two of these courses. During the modelling week, which is held as a block seminar outside the university, the students work in groups on current scientific-technical problems in a mathematical formulation and apply modern numerical methods to them. At the end, the results will be presented and discussed in talks lasting 30-60 minutes. Furthermore, at the latest 4 weeks after the end of the modelling week, a paper that is at least 10 pages in length must be submitted. The oral presentation and the paper will be evaluated in groups. The module grade for the module "Modeling and Status Seminar" is derived from the average of the two grades for the oral presentations and from the two grades for the papers of the annual Modeling Week;

the General Examination and Study Regulations (§ 12 para 2 sentence 4) shall apply. In the status seminar, the students report the activities, study status, and results of their own research in a brief 15-30 minute talk. The status seminar is graded as "passed" or "failed".

c) Module area C: "High-Performance Computing"

Another central component of the degree programme is the professional and efficient implementation of mathematical methods on high-performance computers.

C1: Core elective module "High-Performance Computing"

Modules shall be completed in the amount of 12 credit points from the modules listed in Annex 1.

C2: Computer Internship "Parallel Numerical Methods"

d) Module area D: "Scientific Computing"

This module area is the central area of the degree programme.

D1: Core elective module "Complexity Reduction"

These modules address current methods that are based on the reduction of the information content of a problem and/or of data sets. The complexity is reduced to such an extent that the problem can be dealt with efficiently on parallel computers. Modules shall be completed in the amount of 16 to 24 credit points from the modules listed in Annex 1.

D2: Module "Special Skills in Scientific Computing"

A specialization module from the research areas mentioned in D1 or A2.

e) Module area E: "Soft Skills"

For the development of key qualifications that are not subject-specific (lecture and presentation techniques, computer use, literature research, dealing with specialist literature in foreign languages, teamwork), seminars amounting to a total of 60 hours are to be attended. Completion of the module will be demonstrated by submitting the relevant confirmation of participation and will be assessed as "passed" or "failed".

f) Module area F: "Master's Thesis"

During the first year, students make contact with one of the working groups involved in the elite degree programme. With the support of a supervisor or several supervisors, the students select a research topic for a master's thesis from among the university instructors involved in the elite degree programme, taking into account the student's research interests, which will also offer potential for a later doctorate. The master's thesis should deal with interdisciplinary and application-oriented questions and be related to the focus of the degree programme Scientific Computing. Finding a topic in cooperation with an industrial company, other research institutions, or authorities is expressly desired. In order to support the most efficient and successful handling of the topic, students are to be assigned to research stays of several weeks with proven experts in the relevant fields.

- (2) ¹The master's programme Scientific Computing can be completed as a full-time or part-time student. ²Upon enrolment, the applicant must decide whether he or she wants to complete the programme of study as a full-time or part-time student. ³Changing from full-time to part-time study or from part-time to full-time study is possible within the enrolment period of each new semester. ⁴The programme comprises 4 semesters of full-time study including the master's thesis (standard period of study). ⁵The programme comprises 8 semesters of part-time study including the master's thesis. ⁶Unless special provisions are made in the present regulations, the deadlines specified for full-time study also apply to part-time study.
- (3) A total of 120 credit points must be earned in accordance with the European Credit Transfer System (ECTS).
- (4) New students may begin the programme in the winter semester or the summer semester.

§ 5

Admission to the programme

- (1) Admission requirements for study are:
 - a) a university degree in a bachelor's programme in mathematics, computer science, the natural sciences, or engineering from the University of Bayreuth or an equivalent degree. The degree must have been obtained with a grade of 1,9 or better and

- b) proven skills in numerics amounting to at least 16 credit points. Applicants who are unable to provide proof of these skills will be enrolled on the condition that they submit the proof by the end of the second semester of study at the latest, and
 - c) proof of English proficiency at level B2 of the Common European Framework of Reference for Languages for applicants who have neither obtained their higher education entrance qualification nor their first degree in English, and
 - d) proof of a basic knowledge of the German language at level A1 of the Common European Framework of Reference for Languages for applicants who have neither acquired their higher education entrance qualification nor their first university degree in the German language. Applicants who are unable to provide proof of these skills will be enrolled on the condition that they submit the proof by the end of the second semester of study at the latest, and
 - e) passing the subject-specific aptitude assessment process for the degree programme in accordance with Annex 2.
- (2) ¹With regard to qualifications, the degrees may not show any significant differences from the degrees referred to in para 1 item a. ²If there are substantial compensable differences, applicants may be admitted subject to the proviso that, in addition to the assessment components to be completed in the master's programme and the assessment components from para 1 item b, they also successfully complete coursework and examinations in the amount of up to 10 credit points by the end of the second semester of study at the latest; otherwise, the prerequisites for admission to the programme are deemed not to have been fulfilled. ³In such cases, the examination and study regulations for the bachelor's programmes at the University of Bayreuth given in para 1 item a (as amended) shall apply. ⁴Art. 63 BayHSchG applies to determining the eligibility of domestic and foreign qualifications.
- (3) Such decisions as described in paragraphs 1 and 2 are to be made by the board of examiners established under the terms of § 2 of the General Examination and Study Regulations and § 3 of the present regulations.
- (4) ¹If the bachelor's certificate or equivalent diploma has not yet been issued, a confirmation of all individual grades and examinations for completed courses must be submitted. ²These assessment components must comprise partial examinations totalling at least 150 credit points and with an overall

average grade corresponding to 1,9 or better. 3Applicants who fulfil the requirements of sentence 2 are to be enrolled on the condition that they submit the relevant degree certificate with a grade of 1,9 or better by the end of the second semester of study.

§ 6

Admission to the examinations

Students who are enrolled in the master's programme Scientific Computing are considered *ipso facto* to be admitted to the examinations.

§ 7

Credit transfer

- (1) Awarding credit for competencies (learning outcomes) is governed by Article 63 para 1 and 2 of the Bavarian Higher Education Act (*BayHSchG*).
- (2) 1If credits are awarded for competencies, the grades are to be carried over and included when calculating the final grade, as long as the grading systems are analogous. 2If the grading system of the competences to be credited does not correspond to the grading system of § 12 of the General Examination and Study Regulations, the grades of the other higher education institution shall be converted according to the modified Bavarian formula $x = 1 + 3 \cdot (N_{\max} - N_d) / (N_{\max} - N_{\min})$ with the converted grade x , the best achievable grade N_{\max} , lowest passing grade N_{\min} , and actual grade N_d ; only one digit after the decimal point will be taken into account and there will be no adjustment to the grades mentioned in § 12 of the General Examination and Study Regulations. 3If the grading systems are not analogous, the remark "*bestanden*" ["passed"] shall appear in place of a grade; in this case, the course shall not be taken into account when calculating the final grade. 4The board of examiners in consultation with the relevant representative from the subject area shall decide whether the requirements have been met for credit transfer. 5If credit transfer is denied, the person concerned can appeal the decision by submitting a request for the University Board to review the decision within four weeks of notification of denial. 6The University Board shall provide the board of examiners with a recommendation on how to proceed with the request.
- (3) Credit transfer requests are to be submitted to the board of examiners as soon as possible following enrolment and in any event prior to completing the examination proceedings in the relevant module.

§ 8

Elements of the examination

- (1) The master's examination comprises the module examinations listed in Annex 1 and the master's thesis.
- (2) The examinations serve to demonstrate that the examinee has satisfied the desired learning outcomes of the individual modules.

§ 9

Early transition to doctoral research

Admission to one of the doctoral programmes offered by the *Bayreuth Graduate School of Mathematics and Natural Sciences (BayNAT)* - e.g. *Computational Mathematics in Science and Engineering (BayCompMath)* - can be made in accordance with § 4 para 2 of the Doctoral Regulations of the Bayreuth Graduate School of Mathematical and Natural Sciences (BayNAT).

§ 10

Master's thesis

- (1) ¹The candidate's master's thesis should demonstrate that he or she is able to utilize relevant resources and adequately address and write about current issues in the field using scientific methods over a time frame of 900 hours of work. ²The topic should include interdisciplinary issues.
- (2) ¹The chair of examiners is to determine an examiner to act as supervisor and assessor in consideration of the candidate's wishes. ²The topic of the master's thesis is assigned by a university instructor who is involved in the elite study programme or a university instructor who is involved in the elite study programme via the chair of examiners, as a rule at the end of the second semester for full-time students and at the end of the fourth semester for part-time students. ³Record is to be made of the date on which the topic was assigned.
- (3) ¹The master's thesis is to be integrated into the third and fourth semesters of study for full-time students and the fifth to eighth semesters for part-time students. ²The master's thesis is to be submitted no later than 10 months after the topic was assigned for full-time students and no later than 20 months after the topic was assigned for part-time students. ²In cases in which the candidate is not responsible for missing the deadline, he or she may, at the candidate's request, request that

- the chair of examiners, after hearing the supervisor, extend the deadline by up to two months. ³If the candidate demonstrates via a medical certificate that he or she was unable to work on the thesis, the deadline is to be extended accordingly. ⁴Term papers that are not submitted by the stated deadline are to be graded as "*nicht ausreichend*" ["unsatisfactory"].
- (4) ¹The thesis is to be submitted to the Examinations Office by the deadline given. ²Record is to be made of the date on which the thesis was submitted.
- (5) ¹Three typewritten, paginated, and bound copy of the master's thesis is to be submitted. ²The thesis must contain a table of contents and bibliography. ³An additional copy is to be submitted electronically in PDF format.
- (6) ¹The master's thesis may be written in German or English. ²The master's thesis shall contain a statement at the end in which the author confirms that he or she wrote the thesis independently and did not make use of any sources or materials that are not cited in the thesis. It shall also be confirmed that the thesis had never before been submitted toward fulfilment of an academic degree. ³A synopsis in the German language is to be included if the master's thesis was written in English.
- (7) ¹With the board of examiners' approval, the candidate is entitled to return the topic once within the first two weeks after having been assigned the topic. ²A statement by the supervisor must be submitted. ³Paragraphs 1 to 6 also apply when assigning and working on a new topic.
- (8) ¹The chair of examiners is to be informed by the Examinations Office of submission and shall determine an additional assessor from among the examiners described in § 3 of the General Examination and Study Regulations. ²The Examinations Office shall forward the thesis to the relevant assessors. ³The reports shall be available no later than two months after receipt of the work. ⁴Each assessor shall recommend to the board of examiners that the paper be accepted or rejected and shall at the same time determine one of the grades listed in § 12 of the General Examination and Study Regulations. ⁵In special cases, the board of examiners may call upon an additional examiner, especially if the grades assigned vary by more than one point.
- (9) ¹If their assessments differ under the terms of § 10 para 8 sentence 5, the assessors shall engage in a discussion in which they try to agree on a grade in consideration of subject-related aspects. ²If they cannot reach agreement, they are to inform the chair of examiners.

3In such cases, the chair of examiners shall appoint a third expert, who shall determine the grade on the basis of the two assessments available.

- (10) If the master's thesis is deemed "*nicht ausreichend*" ["unsatisfactory"], the chair of examiners or his or her deputy shall inform the candidate of the decision.
- (11) One copy of the master's thesis is to remain on record.
- (12) The master's thesis can also be completed as part of a fast track doctorate in one of the doctoral programmes - e.g. *Computational Mathematics in Science and Engineering* (BayComp-Math) - offered by the *Bayreuth Graduate School of Mathematics and Natural Sciences* (BayNAT).

§ 11

Final grade

- (1) ¹The overall grade of the master's examination is calculated from the average of the final module grades (§ 12 of the General Examination and Study Regulations) in accordance with Annex 1 and from the grade of the master's thesis (§ 10 of these Statutes), which are weighted with the credit points of the relevant module. ²In this calculation, the grade shall only be given to one decimal place; the remaining digits are to be truncated (not rounded). ³If more modules than the ones required by the present regulations are taken in the elective modules (A2, B2, C1, D1), only the best passing grades shall be used in the calculation of the final grade. ⁴Additional voluntary credits are not to be taken into account in the calculation of the final grade.
- (2) Candidates with a grade average of up to 1,2 the grade "excellent" as the overall grade for the master's examination, up to 1,5 the grades "very good", up to 2,5 "good", up to 3,5 "satisfactory", up to 4,0 "sufficient".
- (3) Calculation of the final grade is to be carried out by the chair of examiners; the certificate or an attached document shall indicate how the final grade was calculated.
- (4) ¹In addition to the degree certificate, an ECTS grading table will be issued as stipulated in the ECTS guidelines in the version dated 6 February 2009. ²This table displays what percentage of programme graduates in a given time frame received the same final grade as described in para 2. ³Those programme graduates who were awarded their diplomas in the previous 8 semesters shall serve as the reference group as long as it includes at least 30 persons. ⁴The date of the last examination shall be decisive in assigning graduates to a particular semester. ⁵If the minimum number of graduates is not reached, the number of previous semesters is to be extended

until the minimum number is reached. 6If the programme of study does not yet have as many graduates as the minimum number required of the reference group, an ECTS grading table will be issued as soon as the minimum number is reached. 7For degrees awarded before the minimum number is reached, an ECTS grading table will be issued at a later date upon request once the minimum number has been reached. 8The graduate's own graduating class is also to be included in the reference group. 9The size of the reference group and the timeframe is to be included.

§ 12

Passing the master's examination

- (1) Passing the master's examination requires a grade of sufficient ("*ausreichend*") or better for the master's thesis and each module; in addition, all 120 credit points must be earned and all requirements mentioned in § 5 para 2 of the present regulations must be fulfilled.
- (2) 1If the candidate has not fulfilled the requirements given in para 1 by the end of his or her 6th semester in full-time study or 12th semester in part-time study due to reasons under his or her control, then the candidate shall be considered as having failed the master's examination on the first attempt. 2Examinations that were taken on time and for which the candidate received a passing grade need not be repeated.
- (3) 1If the missing examinations or the master's thesis are not passed by the student within a year of the deadline given in para 2 sentence 1, or if all possibilities to repeat the examinations have been exhausted, then the candidate shall be considered as having failed the master's examination on the final attempt. 2The deadline shall not take into account periods of leave and periods during which the candidate withdrew from study. 3Notice shall be sent to inform the candidate that he or she has failed an examination on the final attempt in accordance with § 2 para 5 of the General Examination and Study Regulations in conjunction with Article 41 of the Bavarian Administrative Procedures Act (*BayVwVfG*) as amended. 4The board of examiners may grant the student an extension of the deadline for circumstances beyond his or her control if the student submits a request prior to the deadline described in sentence 1.

§ 13

Repeating examinations

- (1) Any examination that was failed on the first attempt can be repeated once.
- (2) 1Voluntarily repeating examinations that were already passed or the master's thesis is not permitted. 2If further assessment components (additional examinations) are completed in the core elective modules (A2, B2, C1, D1)

beyond what is required, there is no obligation to repeat them.

- (3)
 - 1 Repeating an examination for a second time is only permitted for up to three examinations. Repeating a failed examination for a third time is only permissible after subject-specific advising.
 - 2 Students who fail the final repetition of an examination are to be considered as having failed the master's examination on the final attempt.
 - 3 The second or third repetition may be held as a different form of examination in accordance with § 9 of the General Examination and Study Regulations; this is determined by the examiner.
- (4)
 - 1 If a selection of several different courses is available for a module (core elective module), both the course and the module to be taken with it must be specified to the Examinations Office when registering for an examination.
 - 2 Each examination attempt in the module examination for the course counts as one examination attempt for the specified module.
 - 3 On application to the Examinations Office, the course selected for the module may be changed either before the first or before the second repetition examination within the scope of the module's options; such a change may only take place once per module.
- (5)
 - 1 The master's thesis can be repeated with a new topic if the student receives a failing grade for the thesis.
 - 2 Repeating the master's thesis for a second time is not permitted.
- (6) Administrative measures shall be taken to ensure that it is possible to repeat the failed examinations or a failed master's thesis within six months.

§ 14

Awarding the master's degree; diploma

- (1)
 - 1 A diploma and a degree certificate for successful completion of the master's examination are to be issued within 4 weeks of demonstrating completion of the required module credits.
 - 2 The diploma is to include the title of the programme of study.
 - 3 It is to be signed by the Dean of the Faculty of Mathematics, Physics & Computer Science and stamped with the seal of the University.
 - 4 Upon issuance of the diploma, the graduate is given the right to bear the title "Master of Science".
 - 5 This title is to be abbreviated "M.Sc." and placed behind the surname.
- (2)
 - 1 The certificate is to include the title of the programme of study, the final grade, all module examinations undertaken (including credit points and grades achieved), as well as the topic of the master's thesis and the grade received for the thesis.
 - 2 The certificate is to be signed by the chair of examiners.
 - 3 The date to be used is the day of the last module examination.

⁴An English translation of the diploma and a Diploma Supplement shall be issued in addition; the Diploma Supplement shall be signed by the chair of examiners. ⁵In addition to the certificate, an ECTS grading table is to be issued under the terms of § 11 para 4.

(3) Revoking the degree "Master of Science" is to be carried out in accordance with Article 69 BayHSchG.

§ 15

Effective date

¹These regulation go into effect on 8 June 2019. ²They shall be valid for those students enrolling in this programme for the first time in Winter Semester 2019/2020 or later.*)

*) This set of amendments contains the following provisions with regard to the effective date:
The present regulations go into effect on 21 November 2019.

Annex 1: Module overview, credit points, examinations, overall grade

The following overview shows how many credit points are earned in each module, the form of assessment for the module, and the modules that are included in the overall grade.

Area Modules	Credit points and semester hours	Type of examination	Assessment components relevant to the final grade
Area A "Numerical Mathematics"	6-22 credit points		
Module A1 "Numerical Methods for Differential Equations" (§ 4 para 1 item a)	6 credit points 6 semester hours	Written examination or oral examination	X
Core elective modules A2 "Advanced Topics in Numerical Mathematics" (§ 4 para 1 item a)	0-16 credit points	Written or oral examinations	X
Module A2.1 "Numerical Methods for General Types of PDEs"	8 credit points 6 semester hours		
Module A2.2 "Constructive Approximation Methods"	8 credit points 6 semester hours		
Module A2.3 "Mathematical Control Theory"	8 credit points 6 semester hours		
Module A2.4 "Nonlinear Optimization"	8 credit points 6 semester hours		
Module A2.5 "Optimization of Differential Equations"	8 credit points 6 semester hours		
Area B "Modeling and Simulation"	32-40 credit points		
Module B1 "Applied Functional Analysis" (§ 4 para 1 item b)	8 credit points 6 semester hours	Written examination or oral examination	X
Core elective modules B2 "Modeling and Simulation" (§ 4 para 1 item b)	8-16 credit points	Written or oral examinations	X
Module B2.1 "Partial Differential Equations and Integral Equations"	8 credit points 6 semester hours		
Module B2.2 "Modeling with Differential Equations"	4 credit points 3 semester hours		
Module B2.3 "Mathematical Modeling for Climate and Environment"	8 credit points 6 semester hours		
Module B2.4 "Pattern Recognition"	4 credit points 2 semester hours		

Module B2.5 "Computational Biophysics"	4 credit points 3 semester hours	oral examination	
Module B2.6 "Simulation of Biophysical Systems"	4 credit points 4 semester hours		
Module B2.7 "Bioinformatics: Molecular Modeling"	4 credit points 3 semester hours		
Module B2.8 "Foundations of Bioinformatics"	4 credit points 5 semester hours		
Module B2.9 "Higher Strengths of Materials"	4 credit points 4 semester hours		
Module B2.10 "Computer Aided Engineering"	4 credit points 2x2 semester hours	Written examination	
Module B2.11 "Model Building and Simulation of Mechanical Systems"	6 credit points 3+2 semester hours	Written examination	
Module B2.12 "Foundations of Data Management"	4 credit points 2+1 semester hours		
Module B3 "Industrial Internship" or Alternative assessment components amounting to 8 credit points from the core elective modules D1 (§ 4 para 1 item b)	8 credit points	Internship report	
Module B4 "Modeling and Status Seminar"	8 credit points	Talk and paper	X
Area C "High-Performance Computing"	14 credit points		
Core elective modules C1 "High-Performance Computing"	12 credit points	Written or oral examinations	X
Module C1.1 "Algorithms and Data Structures II"	8 credit points 6 semester hours		
Module C1.2 "Algorithms and Data Structures III"	4 credit points 3 semester hours		
Module C1.3 "Parallel and Distributed Systems I"	4 credit points 3 semester hours	Written examination	
Module C1.4 "Parallel and Distributed Systems II"	4 credit points 3 semester hours	Written examination	
Module C1.5 "High-Performance Computing"	8 credit points 6 semester hours	Written examination	
Module C1.6 "Parallel Algorithms"	4 credit points 3 semester hours		
Module C1.7 "Programming and Data Analysis in Python"	4 credit points 3 semester hours		
Internship "Parallel Numerical Methods"	2 credit points	Oral examination	X

Area D "Scientific Computing"	20-28 credit points		
Core elective modules "Complexity Reduction"	16-24 credit points	Written or oral examination	X
Module D1.1 "Efficient Treatment of Non-Local Operators"	8 credit points 6 semester hours		
Module D1.2 "Fast Methods for Differential and Integral Equations"	8 credit points 6 semester hours		
Module D1.3 "Efficient Numerical Treatment of Multiscale Problems"	8 credit points 6 semester hours		
Module D1.4 "Numerical Methods for Uncertainty Quantification"	4 credit points 3 semester hours		
Module D1.5 "High-Dimensional Approximation"	4 credit points 3 semester hours		
Module D1.6 "Data Analytics"	8 credit points 2x3 semester hours		
Module D1.7 "Complexity Reduction in Control"	4 credit points 3 semester hours		
Module D1.8 "Meshfree Methods"	4 credit points 3 semester hours		
Module D1.9 "Boundary Element Methods"	4 credit points 3 semester hours		
Module D1.10 "Optimization Methods in Machine Learning"	4 credit points 3 semester hours		
Module D2 "Special Skills in Scientific Computing"	4 credit points 3 semester hours	Written examination or oral examination	X
Area E "Soft Skills"	2 credit points	Certificates of participation in seminars comprising 60	
Area F Master's Thesis	30 credit points		X
TOTAL	120 credit points		

Annex 2: Aptitude assessment process

1. Purpose of aptitude test

1The aim of the aptitude test is to open access to the elite degree programme *Scientific Computing* to qualified and particularly motivated students. 2The aptitude assessment process plays a special role in interdisciplinary, internationally oriented elite degree programmes since they are geared towards applicants from different countries, subject area cultures, and grading cultures. 3The supplementary selection process will assess the applicant's suitability.

2. Board responsible for the aptitude assessment process

The preparation and implementation of the aptitude assessment process is the responsibility of the board of examiners in accordance with § 2 of the General Examination and Study Regulations for Bachelor's and Master's Programmes in Mathematics at the University of Bayreuth (as amended).

3. Process for determining aptitude

3.1 1The aptitude assessment process is administered twice annually, in the summer and winter semesters. 2Applications for admission to the aptitude assessment process must be submitted to the board of examiners by 15 May (admission for Winter Semester) or 15 November of the previous year (admission for Summer Semester) using the forms issued by the University of Bayreuth. 3Documents described in No. 3.2 may be submitted for Winter Semester by 15 July and for Summer Semester by 15 February.

3.2.1 A cover letter in English in which the reasons for the application are briefly explained.

3.2.2 1The bachelor's degree certificate along with confirmation of individual grades for the examinations and coursework completed during one's studies. 2If the bachelor's degree certificate is not yet available, confirmation containing the individual grades for all examinations and courses up to the registration deadline must be submitted. 3Such credit for examinations and coursework must amount to a total of at least 150 ECTS points

and either have an average grade of at least 1.9 according to the overall grade calculation. ⁴The bachelor's degree certificate is to be submitted by the end of the second semester of study.

3.2.3 If applicable, a list of modules from the applicant's bachelor's studies for which evidence of completion cannot yet be submitted.

3.2.4 A CV as supplementary information.

3.2.5 Other qualifications/achievements (e.g. awards, internships, scholarships, stays abroad)

3.2.6 If applicable, a request for compensation for disadvantages in accordance with § 10 of the General Examination and Study Regulations for Bachelor's and Master's Programmes in Mathematics at the University of Bayreuth (as amended).

4. Admission to the aptitude assessment process

4.1 Admission to the assessment process requires that the documents listed in number 3.2 be submitted on time.

4.2 The aptitude assessment process (number 5) is to be administered to those applicants who fulfil the requirements.

4.3 Applicants who are not admitted are to be sent a notice of denial with a rationale and information concerning legal remedies available; number 6.1 applies *mutatis mutandis*.

5. Overview of the aptitude assessment process

5.1 ¹On the basis of the application documents submitted, the board of examiners shall determine whether the applicant is suited for studies in the master's programme Scientific Computing in view of his or her qualification and the specific talents and abilities he or she described. ²The evaluation process is to be conducted on the basis of the following criteria:

5.1.1 ¹The additional qualifications obtained based on the documents referred to in 3.2.2 and 3.2.5 will be assessed with a maximum of 4.0 points. ²The qualities to be evaluated are the extent to which the applicant's previous achievements reveal distinct abilities and skills in the field of *scientific computing* and his or her potential to work in an interdisciplinary and international environment.

³These qualifications may be evidenced under the terms of items (a) and (b) below:

- a) Evidence of international skills, e.g. stays abroad, Language courses, attendance of foreign-language courses
- b) Proof of interdisciplinary skills such as completion of interdisciplinary courses, internships, vocational training.

⁴The awarding of points for the individual assessments is described in more detail in the Annex to this aptitude assessment process.

5.1.2 ¹The subject-specific coursework and examinations from the bachelor's programme or an equivalent programme of study are to be graded with up to 4.0 points under the terms of § 5. ²Specific conversion factors may be applied for foreign applicants. ³The following shall be taken into account

- The assessment components in mathematics with applied mathematics and numerics (up to 2 points)
- Knowledge of computer science and programming (max. 1 point)
- Knowledge of an applied subject related to the fields of application represented in the degree programme (max. 1 point)

5.1.3 ¹The number of points for the assessment is calculated as the sum of the individual assessments (number 5.1.1 to 5.1.2). ²The number of points for the applicant is determined by taking the arithmetic mean of the individual assessments of the board members. ³The score is to be rounded to one decimal place behind the comma.

5.2 Applicants who received 5.0 points or more shall be sent a confirmation - signed by the chair of the committee - of having passed the aptitude assessment process.

5.3 Candidates who have scored less than 3.0 points will receive a letter of denial under the terms of No. 6.1.

5.4 ¹The other candidates will be invited to an interview. ²The date and time of the interview are to be announced at least two week in advance. ³The applicant is to comply with the date and time of the interview. ⁴Anyone who fails to appear on the date and time announced will be denied admission. ⁵If a reason beyond the applicant's control prevents him or her from participating in the interview, a new appointment is to be scheduled no later than two weeks prior to the start of lectures upon justified request.

- 5.5 1The interview is to be conducted individually in the English language for each applicant. 2The interview is to last between 15 and 30 minutes for each applicant and should demonstrate whether it is to be expected that the aim of the programme of study can be achieved given the applicant's skills and abilities. 3The interview should corroborate the impression that he or she is suited for the programme of study. 4In a short talk, the applicant presents his or her bachelor's thesis or a corresponding project. 5The applicant should demonstrate his/her professional qualification and ability to communicate in an interdisciplinary manner in the talk and the subsequent discussion. 6With the applicant's consent, a student representative may be admitted as a listener. 7The interview is to be conducted by two members of the committee. 8Each member records the result of the interview on a scale of 0 to 4.0 points, with 0 being the worst score and 4.0 the best score. 9The talk and discussion should be taken into account in the assessment. 10The number of points for the applicant is determined by taking the arithmetic mean of the individual assessments of the committee members. 11The score is to be rounded to one decimal place behind the comma.
- 5.6 1The overall assessment of the aptitude assessment process is made up of the score for the interview and the previous studies as described in number 5.1.2. 2Applicants who received 5.0 points or more in the second stage of the aptitude assessment process shall be sent a confirmation of having passed the aptitude assessment process.
- 5.7 1A written record shall be made of the interview, indicating the date, duration, location, name of committee members involved, the name of the applicant, the assessment of the committee members, and the overall outcome. 2The record must show the topics of the interview with the applicant and the rationale for the assessment. 3The reasons and topics may be listed in note form. 4The record sheet is to be signed by the committee members.

6. Notification of the outcome

- 6.1 1The outcome of the aptitude assessment process is to be sent to the applicant in writing. 2The notice is to be signed by the chair of the selection committee. 3A notice of rejection must be accompanied by a rationale and information on one's right to appeal.

4As part of its supervisory duties in accordance with Article 20 para 3 sentence 1 *BayHSchG*, the chair of the selection committee, on behalf of the University Governing Board, shall check a random sample of 10 % of denials of admission.

- 6.2 Admission based on the aptitude assessment process for the master's programme Scientific Computing shall remain valid for future applications to this programme of study as long as the content and goals of the programme do not change so significantly that aptitude for this programme can no longer be demonstrated by having undergone the aptitude assessment process at an earlier date.

7. Repeating the process

Applicants who did not provide evidence of aptitude for the master's programme Scientific Computing may register for the aptitude assessment process one more time.

Annex to the aptitude assessment process:

The following assessment shall be authoritative for the award of points for suitability on the basis of the documents referred to in point 5.1.1:

POINTS	ASSESSMENT
3.0 – 4.0 points	very well-suited for the programme of study
2.0 – 2.9 points	above-average suitability for the programme of study
1.0 – 1.9 points	average suitability for the programme of study
0.0 – 0.9 points	below-average suitability for the programme of study

Issued on the basis of the decision of the University of Bayreuth's Senate of 12 December 2018, the President's expedited decision of 6 June 2019, the agreement of the Bavarian State Ministry of Science and Art of 16 April 2019, and the approval of the President of the University of Bayreuth of 6 June 2019, Ref. No. A 4150/30 - I/1a.

Bayreuth, 7 June 2019

[university seal]

University of Bayreuth
[signature]
Professor Dr. Stefan Leible

These regulations were enacted at the university on 7 June 2019.

This was announced on 7 June 2019 by posting a notice at the university. The date of the announcement is 7 June 2019.

Bayreuth, 7 June 2019

[university seal]

University of Bayreuth, the President
[signature]
Professor Dr. Stefan Leible