BMS Study Regulations

(Dated: July 2020)

1. INTRODUCTION

The Berlin Mathematical School (BMS) is the joint graduate school of the mathematics departments of Freie Universität Berlin, Humboldt-Universität zu Berlin and Technische Universität Berlin and forms the graduate program of the Berlin Mathematics Research Center MATH+. It is the declared goal of each BMS student to obtain a doctoral degree in mathematics at one of these universities, or in exceptional cases at Universität Potsdam.

The BMS study program consists of two phases. Students with a bachelor's degree are admitted to Phase I, which consists primarily of coursework at the graduate level and lasts up to four semesters. Upon successful completion of Phase I, students move into Phase II, which is centered on research leading to a doctoral dissertation, and typically lasts five to six semesters. Students who hold a master's degree can be admitted directly into Phase II if they demonstrate the excellence, depth and breadth expected.

The BMS awards certificates for the successful completion of each phase of studies, but does not itself award degrees. Phase I students will be registered as master's students at one of the three Berlin universities. Although the BMS does not require the completion of a master's degree, this is strongly recommended for most students. In particular, some external sources of funding for Phase II are available only to those with a master's degree. Students wishing to receive a master's degree need to follow the study regulations (*Studienordnung*) of their university.

Each Phase II student has a dissertation supervisor from the BMS faculty and will be registered as a doctoral student at the university where the supervisor is based. Again, because the degree will be awarded by that university, the student needs to be aware of and follow its doctoral regulations (*Promotionsordnung*) in addition to these BMS study regulations.

These regulations apply to all new students entering the BMS; current students as of July 2020 can choose whether to follow this version or the previous one.

2. BMS COURSES

The BMS groups its mathematical activities into various Research Training Areas, each covering a broad but coherent part of mathematics, and typically including both pure and applied topics. There are currently eight BMS Areas:

1. Differential geometry, global analysis and mathematical physics

2. Algebraic and arithmetic geometry, number theory

3. Stochastics and mathematical finance

4. Discrete mathematics and optimization

5. Geometry, topology and visualization

6. Numerical analysis and scientific computing

7. Applied analysis and differential equations

8. Mathematics of data science

The BMS offers three types of courses: Basic Courses, Advanced Courses and Additional Courses. Each course is also an offering of one of the universities and is open to all interested students in Berlin. All BMS courses are offered in English (assuming at least one student requests this).

The BMS Basic Courses form the core of the Phase I study program and are designed to introduce students to research in a given area, while illuminating interdisciplinary connections and applications, modern trends and current problems. They give students the necessary foundation to enable them, after the completion of Phase I, to continue directly into the research-oriented dissertation phase.

In each of the BMS Areas, there are at least two Basic Courses; sometimes these form a two-semester sequence, while in other cases they can be taken independently. Each Basic Course meets for four hours per week of lectures and carries regular homework assignments, which are usually discussed in a two-hour exercise section each week. (Occasionally, one of the universities may offer a course with two hours of lectures, covering half the material of one of the Basic Courses; such a course counts as half of a Basic Course for the purposes of the

Phase I requirements in part 5.) The BMS makes every effort to ensure that each Basic Course is offered at least once during every academic year at one or more of the Berlin universities.

In each area, there are also BMS Advanced Courses, covering topics beyond those of the Basic Courses and often varying from semester to semester. These courses typically meet for either two or four hours of lectures per week. Some Advanced Courses take the form of student seminars, where each participant gives a presentation to the class.

The BMS Additional Courses are courses at an advanced undergraduate level. They are offered by the BMS in English to help those students who need some extra background knowledge. They do not count towards the BMS requirements for Phase I, but can typically be used for credit towards a master's degree.

In advance of each semester, the BMS courses that will be offered are listed on the BMS website. It can happen that a course at one of the universities is not listed, even though it is equivalent to one of the BMS Basic Courses or is at the level of an Advanced Course. In this case students can apply to have the course considered as a BMS course for the purposes of the Phase I requirements listed in part 5.

3. BMS GRADES

The grading for a BMS course is typically based on an exam (either oral or written) at the end of the semester, which is held according to the regulations of the respective university. Grades for courses – and for the BMS Qualifying Exam described in part 6 – are reported in the standard German numerical system, where 1.0 is a perfect grade and 5.0 is a failing grade. The possible numerical grades are shown in the following table, along with the approximately equivalent US letter grades, the German grades in words, and translations into English:

1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	5.0
A	A-	B+	B	B-	C+	C	C-	D+	D	F
sehr gut		*gut*			*befriedigend*			*ausreichend*		*ungenügend*
very good		good			satisfactory			sufficient		failing

“Very good” reflects outstanding performance, while “good” reflects performance significantly above average. “Satisfactory” reflects performance meeting average standards, while “sufficient” reflects performance meeting minimum standards despite faults.

4. OTHER ELEMENTS OF THE BMS STUDY PROGRAM

The MATH+ Friday Colloquium brings distinguished mathematicians from around the world to Berlin to give talks designed to be accessible to all BMS students. These colloquium lectures are preceded by the student-organized “What is …?” seminars. The BMS also offers soft-skills seminars each semester, concerning topics such as time management, presentation skills and intercultural training. All BMS students – in both Phase I and Phase II – are expected to

participate regularly in these BMS events, including attending soft-skills seminars as appropriate.

In addition to the standard course program, the BMS also regularly offers summer schools and intensive courses, and supports various workshops held in Berlin. These research activities (as well as the Advanced Courses) are often organized in conjunction with one of the Certified Units of the BMS (such as the DFG-funded Research Training Groups and Collaborative Research Centers) or the MATH+ Thematic Einstein Semesters. All BMS students are encouraged to take advantage of these opportunities.

5. PHASE I COURSE REQUIREMENTS

The BMS course requirements for Phase I are designed to encourage both depth and breadth of knowledge in mathematics, giving students an optimal preparation for their dissertation research in Phase II. Each Phase I student has an advisor from the BMS faculty, who helps choose appropriate courses each semester.

During Phase I, students must successfully complete five Basic Courses; no more than two Basic Courses from any single BMS Area will be counted. Students must also successfully complete Advanced Courses as follows: one lecture course of four hours per week (or two of two hours per week) and one seminar. The average grade in these BMS courses must be at least “good” (that is, numerically, better than 2.5); in computing the average, of course a pair of two-hour courses has the same weight as one four-hour course. This coursework is typically completed within the first three semesters, leaving time in the fourth semester for a possible master's thesis and the BMS Qualifying Exam.

Students who enter the BMS having already completed courses equivalent to one or more of the BMS Basic Courses can apply to have up to three of these count towards the course requirements above. (Grades from other universities will not be considered when computing the average grade for BMS purposes.) In particular, students who enter the BMS with an advanced background in mathematics may be expected to finish Phase I more quickly, since they have little remaining coursework. Please note, however, that courses that have been used for credit for a previous degree cannot typically be applied for credit towards a master's degree in Berlin.

6. BMS QUALIFYING EXAM

The BMS Qualifying Exam is a 90-minute oral exam designed to test the depth and breadth of mathematical knowledge acquired during Phase I and the candidate's readiness to proceed to mathematical research in Phase II. Any Phase I student who has successfully completed the course requirements (with a grade better than 2.5) can apply to take the BMS Qualifying Exam. The application should list the courses taken as well as the proposed topics and examiners for the Qualifying Exam. The three examiners are members of the BMS faculty, and typically include the prospective supervisor for Phase II. The topics and scope of the exam are agreed in advance with the candidate.

Two of the three parts of the BMS Qualifying Exam are devoted to the student's intended area of research. They could start by covering eight semester-hours of coursework, for instance one Basic Course and one Advanced Course, but should go beyond standard coursework. In the case that the student is working on or has completed a master's thesis, these parts of the Qualifying Exam often cover material related to the contents of that thesis, and can even take the form of a thesis defense (with a 30-minute presentation of the thesis followed by 30 minutes of questions on related mathematics).

The final third of the BMS Qualifying Exam is devoted to an unrelated topic. This is typically based on a BMS Basic Course, but should not simply repeat the course exam, instead going somewhat beyond that. Since the BMS Areas overlap to some extent, to ensure the desired breadth it is necessary but not sufficient that this course be from a different BMS Area.

The examiners report the results of each part of the Qualifying Exam to the BMS, not only with a numerical grade, but also by writing a short description of the student's performance. Students who receive an average grade of “good” (better than 2.5) transition into Phase II. (Students receiving a Phase I scholarship will continue to receive it until the end of the semester if Phase II financing has still to be arranged.) Please note that in some cases students who are working towards a master's degree will finish their master's thesis only after their Qualifying Exam. For BMS purposes they are Phase II students during this time.

A student who fails the exam (5.0) the first time will be given a second chance. Any student who fails twice will cease to be a BMS member. In the case of a grade between 2.5 and 4.0, the examiners will recommend whether the student should be given a second chance or should be encouraged to complete a master's degree and then leave the BMS.

7. SUMMARY OF PHASE I REQUIREMENTS

The requirements for BMS Phase I are those outlined in the previous three sections: students should actively participate in the Friday events and attend soft-skills seminars; they must complete the required Basic and Advanced Courses (with an average grade better than 2.5); and they must pass the BMS Qualifying Exam (with an average grade better than 2.5).

8. PHASE II REQUIREMENTS

During Phase II, students work on research for their dissertation, supervised by a member of the BMS faculty. If this supervisor is a member of the postdoctoral faculty or otherwise not a permanent faculty member, a secondary supervisor with permanent status should be named. The student and supervisor(s) sign a supervision agreement, outlining the research plan and their various duties and responsibilities. Should the supervising relationship end, for instance because the supervisor takes up employment at another institution, the BMS will help the student find a replacement.

In addition to their dissertation research, Phase II students should continue to deepen and broaden their mathematical knowledge, in a study program arranged with their supervisor. Typically, this includes one or two Advanced Courses per semester, especially in the first two years of Phase II. Students who are members of one of the BMS Certified Units (such as Research Training Groups and Collaborative Research Centers) should participate in its (structured) program, typically including regular seminar lectures. Phase II students are expected to regularly attend the MATH+ Friday Colloquia and should take advantage of the additional offers of the BMS (such as summer schools and soft-skills training).

Students – especially those intending to apply for postdoctoral positions – should gain teaching experience, for instance by serving as an assistant for one of the BMS Basic Courses.

Phase II of the BMS should usually be completed within six semesters; in particular, the BMS is not able to provide funding beyond that point. The regulations of the individual university govern the submission and defense of the dissertation. With the award of the doctoral degree, the BMS student is welcomed into the ranks of the BMS Alumni, while student membership in the BMS ends.

9. BMS SCHOLARSHIPS

The BMS has a limited number of Phase I scholarships to offer to certain incoming students as part of the BMS admissions process. Phase I scholarships are initially granted for three semesters and can be extended to a fourth semester. Students in Phase I with sufficient German language skills are normally expected to support themselves by other means, either with student jobs like tutoring for undergraduate classes, or by applying for outside scholarships, for instance from the *Studienstiftung des deutschen Volkes*.

Most BMS Phase II students are supported by the various large-scale research projects in Berlin – typically holding positions in MATH+ projects or in the BMS Certified Units – and others are supported by individual research grants of their supervisors. The BMS will help all students find appropriate funding for Phase II, although scholarships from the BMS itself are available only for a small fraction of Phase II students.

Since it is often the case that external funding is available, but only after a delay of several months, the BMS uses some of its scholarship funds for “gap funding”. Any student who has transitioned into Phase II after completing the Phase I coursework and the BMS Qualifying Exam (each with grades of at least “good” as outlined above) can apply for up to six months of gap funding. Gap funding can also be provided later in Phase II, for instance when the source of external funding changes. The BMS, however, cannot provide any scholarship to students who have already received three years of funding for Phase II.

Regular Phase II scholarships from the BMS are initially awarded for two years and are typically extended for a third year (but not more). In keeping with its goal of supporting excellence, the BMS reserves its scholarships for the very best students. In particular, only students with excellent grades are eligible to apply for BMS scholarships: the average grade in the required Phase I courses must be “very good” (better than 1.5) and the average grade on the Qualifying Exam must also be “very good” (better than 1.5). Meeting these criteria is no guarantee of receiving a scholarship; the BMS considers each application carefully and decides on an individual basis.

To apply either for gap funding or for a regular Phase II scholarship, Phase I students must submit the following information:

- grades obtained in Phase I coursework and on the Qualifying Exam (if completed),
- confirmation of regular attendance at Friday events, such as the MATH+ Friday Colloquia,
- research statement about the proposed dissertation project,
- letter of support from the prospective supervisor.

The supervisor's letter should explain the capabilities of the student and the expectations for the dissertation. It must also contain details about efforts to secure other means of funding, details about pending applications for external funding, and, if necessary, an explanation of why no alternative funding is available.

If a student applies for a scholarship before completing the Qualifying Exam, the BMS may choose to award a scholarship, but this offer will be conditional on receiving the required grade on the Qualifying Exam.