## Tokyo Metropolitan University Graduate School Education Curriculum Diploma Policy and Curriculum Organization and Implementation Policies

Program: Graduate School of Science — Mathematical Sciences

## 1. Diploma Policy (DP)

## (1) Degrees to be conferred

[Master's Program] Master's degree (Master of Science): Awarded upon successful completion

[Doctoral Program] Doctorate (Doctor of Science): Awarded upon successful completion

## (2) Certifications to be granted

 Certifications to be granted upon completion: Junior High School Advanced Teacher's License in Mathematics, High School Advanced Teacher's License in Mathematics

Students who have obtained the Junior High School Class 1 Teacher's License in Mathematics and/or High School Class 1 Teacher's License in Mathematics can apply for the above teacher's license upon completion of the master's program at the University.

- ii. Examination eligibility to be granted upon completion: Not applicable
- iii. Certifications to be granted upon completion of a separately specified program: Not applicable
- iv. Programs that waive the examinations of some courses upon completion (Major certifications only): Not applicable

## (3) Educational goals

The Department of Mathematical Sciences aims to develop competent individuals with advanced knowledge of mathematics and applied mathematics as well as flexible and original mathematical and scientific thinking skills. It also seeks to develop those who can solve various issues in natural science and modern information society while being aware of the importance of mathematical science as a foundation of science. Upon completing the program, students will acquire:

[Master's Program]

- · Advanced technical knowledge in mathematical sciences and flexible mathematical thinking skills.
- The ability to initiate projects and conduct research in a systematic manner independently or under the guidance of the graduate advisor.
- The ability to clearly express the research findings and discuss with other researchers.

### [Doctoral Program]

- Advanced technical knowledge in mathematical sciences and flexible and original mathematical thinking skills.
- The ability to conduct original research activities as independent researchers with an international perspective.
- The ability to objectively evaluate the significance of own research and its position in society.

#### (4) Program features

The Department of Mathematical Sciences has a well-balanced faculty in the four fields: algebra, geometry, analysis, and applied mathematics. Instructors teach systematic theories in algebra, geometry, and analysis; and link them organically to the various areas of applied mathematics. Under this approach, students will be trained to think flexibly and will be invited to take part in cutting-edge research in the mathematical sciences, including interdisciplinary aspects. The Department also develops individuals who recognize the importance of mathematical science as a foundation of science and who can solve various problems in natural science and modern information society through interaction with physics, chemistry, and biological sciences major students.

#### (5) Specialized knowledge, R&D skills, and other skills

Students are expected to acquire specialized knowledge in the fields of algebra, geometry, analysis, and applied mathematics and the skills necessary to perform research activities as specifically described in (3). In addition, students will develop the ability to teach specialized knowledge as teachers and the communication and information literacy skills required in companies and research institutions to a level appropriate for a doctoral program.

#### (6) Completion requirements

The requirements for the program completion are as follows: <u>The students currently enrolled are advised to</u> refer to the Graduate Program and Course Outlines issued in the first year of enrollment to check the <u>completion requirements of the enrolled program</u>.

#### [Master's Program]

Students must be enrolled in the program for two years, earn 30 or more credits, take required courses for Mathematical Sciences, including mandatory Exercises in Mathematical Sciences and Seminar in Mathematical Sciences 1, 2, 3, and 4, submit a thesis, and pass the final examination. In this case, if the graduate advisor considers it academically beneficial, up to 10 credits out of the 30 credits may be earned by taking the following courses as prescribed by the graduate school:

- Non-major courses provided by the same graduate program
- Major courses provided by other graduate schools, or
- Undergraduate courses

For those who are recognized as delivering excellent research results, enrollment in the master's program for one year or more shall satisfy the requirement.

 $\bigcirc$  Thesis evaluation process and criteria

An applicant shall decide a thesis title with the prior approval of their graduate advisor and submit the completed thesis to them. The applicant shall submit a degree application with a document certifying that the thesis has been accepted by their graduate advisor. Acceptance/rejection of the degree application shall be decided by the Graduate Faculty Committee. If the application is accepted, the Graduate Faculty Committee shall establish a Review Committee consisting of three or more faculty members, including the chief examiner, with extra examiners from other graduate schools or universities/institutions if necessary. The Review Committee shall rigorously review the content of the submitted thesis. The applicant shall write and submit the master's thesis in Japanese or one of the major languages in Mathematical Sciences (English, German, or French). The applicant shall give a public presentation on the research findings in Japanese or English and answer questions. The Review Committee shall determine pass or fail on the thesis and presentation based on the criteria below and report the result to the Graduate Faculty Committee through the Department Meeting. The Graduate Faculty Committee shall make the final decision on whether to confer a degree.

- (1) Did the applicant show sufficient understanding of the research topic?
- (2) Did the applicant conduct research activities sufficiently during the period of the standard two-year program?
- (3) Did the applicant perform an appropriate analysis of the research findings?

- (4) Was the thesis written in logical and clear language?
- (5) Were the presentation and response to questions in the Master's thesis presentation logical and clear?

#### [Doctoral Program]

Students must be enrolled in the program for three years and earn 20 or more credits, take required courses for Mathematical Sciences, including mandatory courses "Advanced Seminar in Mathematical Sciences 1, 2, 3, 4, 5, and 6," and submit a dissertation and pass the final examination. For those who are recognized as delivering excellent research results, enrollment in the doctoral program for one year or more shall satisfy the requirement. However, for those who have completed the master's program with one-year enrollment, two-year enrollment in the doctoral program satisfies the completion requirement. The process and criteria of dissertation are as follows:

#### $\bigcirc$ Dissertation evaluation process

A prospective applicant shall undergo a preliminary examination in the Department (closed to the public) before proceeding to write a dissertation. If a degree application is approved, the applicant shall decide the dissertation title with the prior approval of their graduate advisor. The applicant shall write a dissertation in one of the major languages in Mathematical Sciences (English, German, or French) and submit the completed dissertation to their graduate advisor and a degree application to the Graduate Faculty Committee. If the application is accepted, the Graduate Faculty Committee shall establish a Review Committee consisting of three or more faculty members, including the chief examiner, with extra examiners from other graduate schools or universities/institutions if necessary. The Review Committee shall review the content of the submitted dissertation. The applicant shall prepare the final version of the dissertation reflecting the advice of the Review Committee and submit it to the Graduate Faculty Committee. The applicant shall give a public presentation on the research findings in English or Japanese and answer questions. The Review Committee shall determine pass or fail on the dissertation and presentation based on the criteria below and report the result to the Graduate Faculty Committee through the Department Meeting. The Graduate Faculty Committee shall make the final decision on whether to confer a degree.

#### $\bigcirc$ Dissertation evaluation criteria

In principle, a doctoral dissertation shall be a comprehensive report of the applicant's ongoing research. All of the following criteria must be satisfied to pass the final examination.

- (1) Is the dissertation original with new findings and insights?
- (2) Were the presentation and response to questions in the dissertation presentation logical and clear?
- (3) Is the level of completion of the dissertation appropriate?
- (4) Has a part of the dissertation been published or will it be published in a peer-reviewed journal as an academic paper (written in the primary language)?
- (5) Are appropriate ethical considerations given to planning and conducting research, presenting the research findings, and storing the data?

#### 2. Curriculum Policy (CP): Policy on curriculum organization and implementation

#### (1) Basic policy on curriculum organization

The curriculum shall be appropriately organized to provide students with a high level of expert knowledge and competence in their field of study and to develop basic knowledge in related fields as follows.

#### [Master's Program]

The Department of Mathematical Sciences provides systematic theories in algebra, geometry, and analysis and links them organically to the various areas of applied mathematics. With this approach, students will be invited to take part in cutting-edge research in the mathematical sciences, including interdisciplinary aspects. In order to achieve this, the following courses are offered as the core curriculum for each field.

- Special Lectures in Algebra (1), (2), (3)
- Special Lectures in Geometry (1), (2), (3)
- Special Lectures in Analysis (1), (2), (3)
- Special Lectures in Applied Mathematics (1), (2), (3)
- Intensive Lectures in Algebra 1, 2
- Intensive Lectures in Geometry 1, 2

• Intensive Lectures in Analysis 1, 2

• Intensive Lectures in Applied Mathematics 1, 2

In addition, the following courses cover interdisciplinary topics.

• Intensive Lectures in Mathematical Sciences 1, 2

The group of highly specialized courses below are taught by full-time faculty members or external lecturers and offers leading-edge research topics.

- Advanced Topics in Algebra 1, 2
- Advanced Topics in Geometry 1, 2
- Advanced Topics in Analysis 1, 2
- Advanced Topics in Applied Mathematics 1, 2

Exercises in Mathematical Sciences is a mandatory course to develop practical skills, including searching and collecting information on mathematical science, writing synthesis reports and research papers, and giving presentations.

The following mandatory courses help students to discover research topics, conduct research activities and complete the research results in a master's thesis under the guidance of the graduate advisor.

- Seminar in Mathematical Sciences 1, 2 (for first-year students)
- Seminar in Mathematical Sciences 3, 4 (for second-year students)

#### [Doctoral Program]

The following courses are the core curriculum for each field of study, and each is offered concurrently with the corresponding master's course.

- Intensive Lectures in Algebra 1, 2
- Intensive Lectures in Geometry 1, 2
- Intensive Lectures in Analysis 1, 2
- Intensive Lectures in Applied Mathematics 1, 2

The following courses are taught by full-time faculty members or external lecturers and offer leadingedge research topics, each is offered concurrently with the corresponding master's course.

- Advanced Topics in Algebra 1, 2
- Advanced Topics in Geometry 1, 2
- Advanced Topics in Analysis 1, 2
- Advanced Topics in Applied Mathematics 1, 2

In addition, Special Exercises in Mathematical Sciences is offered concurrently with Exercises in Mathematical Sciences in the master's program.

The following mandatory courses help students to discover research topics, systematically conduct research activities and complete the research results in a doctoral dissertation under the guidance of the graduate advisor.

- Advanced Seminar in Mathematical Sciences 1, 2 (for first-year students)
- Advanced Seminar in Mathematical Sciences 3, 4 (for second-year students)
- Advanced Seminar in Mathematical Sciences 5, 6 (for third-year students)

#### (2) Policy on teaching and learning methods in the curriculum

The courses shall be taught with various methods and forms, such as lectures, exercises, and practical training, in accordance with the objectives and learning goals of each course so that students can learn independently and actively and acquire the qualities and abilities appropriate to the objectives of human resources development and the degree awarding policy.

Research guidance shall be provided to improve students' research skills and methods under the research guidance plans defined separately.

#### (3) Policy on the assessment of learning outcomes

All courses shall be assessed according to the level of achievement of the course objectives, based on the assessment methods and criteria specified in the syllabus. Theses/dissertations shall be assessed according to the following process and criteria.

[Master's Program]

 $\bigcirc$  Thesis evaluation process and criteria

An applicant shall decide a thesis title with the prior approval of their graduate advisor and submit the completed thesis to them. The applicant shall submit a degree application with a document certifying that the thesis has been accepted by their graduate advisor. Acceptance/rejection of the degree application shall be decided by the Graduate Faculty Committee. If the application is accepted, the Graduate Faculty Committee shall establish a Review Committee consisting of three or more faculty members, including the chief examiner, with extra examiners from other graduate schools or universities/institutions if necessary. The Review Committee shall rigorously review the content of the submitted thesis. The applicant shall write and submit the master's thesis in Japanese or one of the major languages in Mathematical Sciences (English, German, or French). The applicant shall give a public presentation on the research findings in Japanese or English and answer questions. The Review Committee shall determine pass or fail on the thesis and presentation based on the criteria below and report the result to the Graduate Faculty Committee through the Department Meeting. The Graduate Faculty Committee shall make the final decision on whether to confer a degree.

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- (2) Did the applicant conduct research activities sufficiently during the period of the standard twoyear program?
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#### [Doctoral Program]

○ Dissertation evaluation process

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- (5) Are appropriate ethical considerations given to planning and conducting research, presenting the research findings, and storing the data?

# Curriculum Structure of the Department of Mathematical Sciences

A wide range of specialized courses ...... (4); Enrollment (3); Enrollment Special Lectures in Algebra (1), (2), (3) (2) Advanced Topics in Algebra 1(1) Intensive Lectures in Algebra 1 (1), Intensive Lectures in Advanced Topics in Algebra 2(2) Submission and presentation of the doctoral dissertation Algebra 2 (2) 6(2) Submission and presentation of the master's thesis evaluation of the doctoral dissertation Special Lectures in Geometry (1), (2), (3) (2) ъ, Advanced Topics in Geometry 1 (1) Intensive Lectures in Geometry 1 (1), Intensive Lectures in S Advanced Topics in Geometry 2 (2) Sciences Geometry 2 (2) 2 4 Ĺ, ς, Sciences Special Lectures in Analysis (1), (2), (3) (2) Sciences Advanced Topics in Analysis 1(1) courses Intensive Lectures in Analysis 1 (1), Intensive Lectures in courses Advanced Topics in Analysis 2(2) Mathematical Analysis 2 (2) Advanced Topics in Applied Mathematics Special Lectures in Applied Mathematics (1), (2), (3) (2) in Mathematical in Mathematical in specialized n specialized 1(1)Intensive Lectures in Applied Mathematics 1 (1), Intensive Advanced Topics in Applied Mathematics Lectures in Applied Mathematics 2 (2) 2(2) .⊆ Intensive Lectures in Mathematical Sciences (1), (2) (2) Seminar Preliminary Seminar Seminar Courses for dissertation preparation Advanced Exercises in Mathematical Sciences (1) Advanced Advanced ..... Seminar in Seminar in Seminar in Seminar in Mathematical Mathematical Mathematical Mathematical Sciences 1 (3) Sciences 2 (3) Sciences 3 (3) Sciences 4 (3) Master's Year 2, 2nd Master's Year 2, 1st D2 Master's Year 1, 1st Master's Year 1, 2nd D1 D3 **Doctoral program** Master's program