Graduate Major in Mathematics

【Master's Degree Program】

1. Outline

Mathematics is an area that deals with the study of numbers, patterns, spaces, and functions. It has been developed since time immemorial, and is continuously evolving for itself and also as a foundation of natural and social sciences. In this program, students are expected to cultivate abilities to explore the frontiers of modern mathematics and gain professional knowledge as well as enhance logical and critical thinking skills. The program aims to develop mathematicians, academicians, teachers as well as skilled professionals for business and high tech industries.

2. Competencies Developed

The students are expected to acquire

- Advanced theories, notions, and calculations in mathematics, based on what they have learned in the undergraduate program
- Skills to choose a specific problem in their subjects and to obtain a new academic result.

3. Learning Goals

Through this program, the students are expected to:

(a) Acquire theories and notions that are commonly important in all areas of mathematics.

(b) Acquire theories and calculations in their subjects required for the progress of their research.

(c) Learn how the theory of mathematical finance is applied in practical situations.

(d) Read fundamental references (textbooks or research papers) in their subjects thoroughly; also to re-construct what they have learned in their own words; to make presentations about it; and to communicate with the audience.

(e) Write an academic paper on what they have learned and obtained during Graduate Seminars and Graduate Research Seminars.

(f) Acquire necessary scientific culture by taking certain Humanities and Social Science Courses.

(g) Be aware of their connections to society, professions, and careers, and acquire competencies to play an active part in business and industry.

4. IGP Completion Requirements

The following requirements must be met to complete the Master's Degree Program of this major.

1. Attain a total of 31 credits or more from 400- and 500-level courses according to the requirements in Table M1.
2. Pass the master's thesis review and defense.

Table M1 shows course categories and the number of credits required to complete the Master's Degree Program of this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as “associated learning goals”. Prior to registering courses, students need to fully understand the course goals.

Table M1. Graduate Major in Mathematics Completion Requirements

Course category		**<Required courses> Required credits**	**<Electives> Minimum credits required**	**Minimum credits required**	**Associated learning goals**	**Comments**
Liberal arts and basic science courses	**Humanities and social science courses**		•2 credits from 400-level •1 credit from 500-level	5 credits	(f)	
	Entrepreneurship courses		2 credits from 400- or 500-level		(g)	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	**Research seminars**	• 4 credits from 400-level • 4 credits from 500-level		24 credits	(d),(e)	
	Research-related courses		• 4 credits from 400-level • 4 credits from 500-level		(d),(e)	
	Major courses		A total of 8 credits from the Core Courses (Restricted elective A) of the Graduate Major in Mathematics.		(a),(b),(d)	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Mathematics				(c),(f),(g)	

	standard curriculum					
Total required credits		**A minimum of 31 credits including those attained according to the above conditions**				
Note		**・Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level.** **・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.**				

5. IGP Courses

Table M2 shows the Core Courses of the Master's Degree Program in this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

Table M2. Core Courses of the Graduate Major in Mathematics

Course category		**Course number**	**Course title**			**Credits**	**Competencies**	**Learning goals**	**Comments**
Research seminars	**400 level**	MTH.Z491.R	◎	★	Graduate Seminars in Mathematics S1	0-2-0	1,3,4,5	(d)	
		MTH.Z492.R	◎	★	Graduate Seminars in Mathematics F1	0-2-0	1,3,4,5	(d)	
	500 level	MTH.Z591.R	◎	★	Graduate Seminars in Mathematics S2	0-2-0	1,3,4,5	(d)	
		MTH.Z592.R	◎	★	Graduate Seminars in Mathematics F2	0-2-0	1,3,4,5	(d)	
Research-related courses	**400 level**	MTH.R491.A	A ○	★	Graduate Research Seminars in Mathematics S1	0-2-0	1,3,4,5	(d)	Students must take this course with Graduate Seminars in Mathematics S1 (MTH.Z491.R)
		MTH.R492.A	A ○	★	Graduate Research Seminars in Mathematics F1	0-2-0	1,3,4,5	(d)	Students must take this course with Graduate Seminars in Mathematics F1 (MTH.Z492.R)
	500 level	MTH.R591.A	A ○	★	Graduate Research Seminars in Mathematics S2	0-2-0	1,3,4,5	(d)	Students must take this course with Graduate Seminars in

									Mathematics S2 (MTH.Z591.R)
		MTH.R592.A	A ○	★	Graduate Research Seminars in Mathematics F2	0-2-0	1,3,4,5	(d)	Students must take this course with Graduate Seminars in Mathematics F2 (MTH.Z592.R)
Major courses	**400 level**	MTH.A401.A	A ○	★	Advanced topics in Algebra A	1-0-0	1	(a)	Only for even academic years
		MTH.A402.A	A ○	★	Advanced topics in Algebra B	1-0-0	1	(a)	Only for even academic years
		MTH.A403.A	A ○	★	Advanced topics in Algebra C	1-0-0	1	(a)	Only for even academic years
		MTH.A404.A	A ○	★	Advanced topics in Algebra D	1-0-0	1	(a)	Only for even academic years
		MTH.A405.A	A ○	★	Advanced topics in Algebra A1	1-0-0	1	(a)	Only for odd academic years
		MTH.A406.A	A ○	★	Advanced topics in Algebra B1	1-0-0	1	(a)	Only for odd academic years
		MTH.A407.A	A ○	★	Advanced topics in Algebra C1	1-0-0	1	(a)	Only for odd academic years
		MTH.A408.A	A ○	★	Advanced topics in Algebra D1	1-0-0	1	(a)	Only for odd academic years
		MTH.B401.A	A ○	★	Advanced topics in Geometry A	1-0-0	1	(a)	Only for even academic years
		MTH.B402.A	A ○	★	Advanced topics in Geometry B	1-0-0	1	(a)	Only for even academic years
		MTH.B403.A	A ○	★	Advanced topics in Geometry C	1-0-0	1	(a)	Only for even academic years
		MTH.B404.A	A ○	★	Advanced topics in Geometry D	1-0-0	1	(a)	Only for even academic years
		MTH.B405.A	A ○	★	Advanced topics in Geometry A1	1-0-0	1	(a)	Only for odd academic years
		MTH.B406.A	A ○	★	Advanced topics in Geometry B1	1-0-0	1	(a)	Only for odd academic years
		MTH.B407.A	A ○	★	Advanced topics in Geometry C1	1-0-0	1	(a)	Only for odd academic years
		MTH.B408.A	A ○	★	Advanced topics in Geometry D1	1-0-0	1	(a)	Only for odd academic years
		MTH.C401.A	A ○	★	Advanced topics in Analysis A	1-0-0	1	(a)	Only for even academic years
		MTH.C402.A	A ○	★	Advanced topics in Analysis B	1-0-0	1	(a)	Only for even academic years

		MTH.C403.A	A ○	★	Advanced topics in Analysis C	1-0-0	1	(a)	Only for even academic years
		MTH.C404.A	A ○	★	Advanced topics in Analysis D	1-0-0	1	(a)	Only for even academic years
		MTH.C405.A	A ○	★	Advanced topics in Analysis A1	1-0-0	1	(a)	Only for odd academic years
		MTH.C406.A	A ○	★	Advanced topics in Analysis B1	1-0-0	1	(a)	Only for odd academic years
		MTH.C407.A	A ○	★	Advanced topics in Analysis C1	1-0-0	1	(a)	Only for odd academic years
		MTH.C408.A	A ○	★	Advanced topics in Analysis D1	1-0-0	1	(a)	Only for odd academic years
		MTH.D401			Advanced Topics in Mathematical Finance A	1-0-0	1	(c) (g)	Outside the standard curriculum
		MTH.D402			Advanced Topics in Mathematical Finance B	1-0-0	1	(c) (g)	Outside the standard curriculum
		MTH.D403			Advanced Topics in Mathematical Finance C	1-0-0	1	(c) (g)	Outside the standard curriculum
		MTH.D404			Advanced Topics in Mathematical Finance D	1-0-0	1	(c) (g)	Outside the standard curriculum
		MTH.E431.A	A ○		Special lectures on advanced topics in Mathematics A	2-0-0	1	(d)	Only for even academic years
		MTH.E432.A	A ○		Special lectures on advanced topics in Mathematics B	2-0-0	1	(d)	Only for even academic years
		MTH.E433.A	A ○		Special lectures on advanced topics in Mathematics C	2-0-0	1	(d)	Only for even academic years
		MTH.E434.A	A ○		Special lectures on advanced topics in Mathematics D	2-0-0	1	(d)	Only for even academic years
		MTH.E435.A	A ○		Special lectures on advanced topics in Mathematics E	2-0-0	1	(d)	Only for even academic years
		MTH.E436.A	A ○	★	Special lectures on advanced topics in Mathematics F	2-0-0	1	(d)	Only for even academic years
		MTH.E440.A	A ○		Special lectures on advanced topics in Mathematics Q	2-0-0	1	(c)	
		MTH.E443.L		★	Special Lecture on Science in English (Mathematics 5)	1-0-0	1	(b)	**Not available in AY 2024**
		MTH.E444.L		★	Special Lecture on Science in English (Mathematics 6)	1-0-0	1	(b)	**Not available in AY 2024**
		MTH.K401.L			Mathematical Science Special Exercises A	0-1-0	4,5	(g)	
		MTH.K402.L			Mathematical Science Special Exercises B	0-1-0	4,5	(g)	
		MTH.K403.L			Mathematical Science Special Exercises C	0-1-0	4,5	(g)	

		MTH.K404.L			Mathematical Science Special Exercises D	0-1-0	4,5	(g)	
		MTH.K405.L			Mathematical Science Internship MA	0-1-0	5	(g)	
	500 level	MTH.A501.A	A ○	★	Advanced topics in Algebra E	1-0-0	1	(b)	Only for even academic years
		MTH.A502.A	A ○	★	Advanced topics in Algebra F	1-0-0	1	(b)	Only for even academic years
		MTH.A503.A	A ○	★	Advanced topics in Algebra G	1-0-0	1	(b)	Only for even academic years
		MTH.A504.A	A ○	★	Advanced topics in Algebra H	1-0-0	1	(b)	Only for even academic years
		MTH.A505.A	A ○	★	Advanced topics in Algebra E1	1-0-0	1	(b)	Only for odd academic years
		MTH.A506.A	A ○	★	Advanced topics in Algebra F1	1-0-0	1	(b)	Only for odd academic years
		MTH.A507.A	A ○	★	Advanced topics in Algebra G1	1-0-0	1	(b)	Only for odd academic years
		MTH.A508.A	A ○	★	Advanced topics in Algebra H1	1-0-0	1	(b)	Only for odd academic years
		MTH.B501.A	A ○	★	Advanced topics in Geometry E	1-0-0	1	(b)	Only for even academic years
		MTH.B502.A	A ○	★	Advanced topics in Geometry F	1-0-0	1	(b)	Only for even academic years
		MTH.B503.A	A ○	★	Advanced topics in Geometry G	1-0-0	1	(b)	Only for even academic years
		MTH.B504.A	A ○	★	Advanced topics in Geometry H	1-0-0	1	(b)	Only for even academic years
		MTH.B505.A	A ○	★	Advanced topics in Geometry E1	1-0-0	1	(b)	Only for odd academic years
		MTH.B506.A	A ○	★	Advanced topics in Geometry F1	1-0-0	1	(b)	Only for odd academic years
		MTH.B507.A	A ○	★	Advanced topics in Geometry G1	1-0-0	1	(b)	Only for odd academic years
		MTH.B508.A	A ○	★	Advanced topics in Geometry H1	1-0-0	1	(b)	Only for odd academic years
		MTH.C501.A	A ○	★	Advanced topics in Analysis E	1-0-0	1	(b)	Only for even academic years
		MTH.C502.A	A ○	★	Advanced topics in Analysis F	1-0-0	1	(b)	Only for even academic years
		MTH.C503.A	A ○	★	Advanced topics in Analysis G	1-0-0	1	(b)	
		MTH.C504.A	A ○	★	Advanced topics in Analysis H	1-0-0	1	(b)	

		MTH.C505.A	A ○	★	Advanced topics in Analysis E1	1-0-0	1	(b)	Only for odd academic years
		MTH.C506.A	A ○	★	Advanced topics in Analysis F1	1-0-0	1	(b)	Only for odd academic years
		MTH.C507.A	A ○	★	Advanced topics in Analysis G1	1-0-0	1	(b)	Only for odd academic years
		MTH.C508.A	A ○	★	Advanced topics in Analysis H1	1-0-0	1	(b)	Only for odd academic years
		MTH.E531.A	A ○		Special lectures on advanced topics in Mathematics G	2-0-0	1	(d)	Only for odd academic years
		MTH.E532.A	A ○		Special lectures on advanced topics in Mathematics H	2-0-0	1	(d)	Only for odd academic years
		MTH.E533.A	A ○		Special lectures on advanced topics in Mathematics I	2-0-0	1	(d)	Only for odd academic years
		MTH.E534.A	A ○		Special lectures on advanced topics in Mathematics J	2-0-0	1	(d)	Only for odd academic years
		MTH.E535.A	A ○		Special lectures on advanced topics in Mathematics K	2-0-0	1	(d)	Only for odd academic years
		MTH.E536.A	A ○		Special lectures on advanced topics in Mathematics L	2-0-0	1	(d)	Only for odd academic years
		MTH.K501.L			Special Career Program of Mathematical Science	0-1-0	3,4,5	(g)	
		MTH.K502.L			Mathematical Science Internship MB	0-1-0	5	(g)	

Note：

• ◎：Required course, ○：Restricted elective, ★：Classes in English

• Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)

• The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ABC.D400.R): A: Algebra, B: Geometry, C: Analysis, D: Courses on practical aspects in Mathematical Finance, Z: Research Seminars

6. IGP Courses That Can Be Counted as Humanities and Social Science Courses

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the master's degree program, students must attain at least two credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table M-1 of the "Entrepreneurship Courses" listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the

time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table M3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program.

As there are some Entrepreneurship Courses without GAs, please check carefully before registering for them.

However, it must be noted that credits attained from courses that are recognized as equivalent to Entrepreneurship Courses can be counted towards the completion requirements of the master’s degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.
The Graduate Attributes of the Master's Degree Program are listed in Table M-1 as follows:

GA0M: You can clearly plan your own career and recognize the abilities necessary for realizing it while considering ethics and relevance to societal problems.

GA1M: You can acquire the knowledge, skills, ethics and entrepreneurship necessary for realizing your planned career and contribute to societal problem-solving while collaborating with other experts

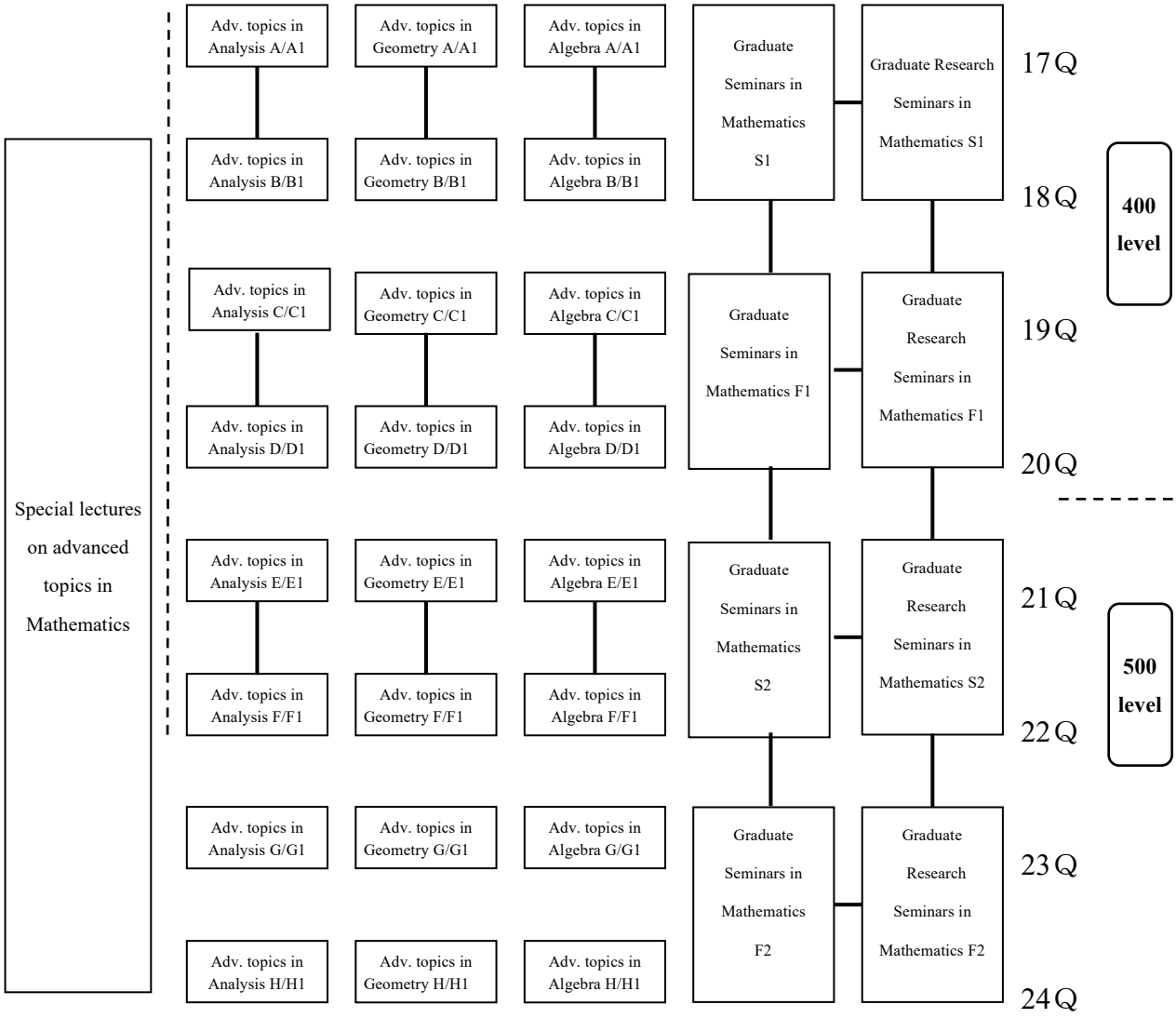
Table M3. Courses of the Graduate Major in Mathematics recognized as equivalent to Entrepreneurship Courses, and Entrepreneurship Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	XIP.A401		★	Special International Practice in Science	1-0-0	GA1M		Common Course of School of Science Outside the Graduate Major in Mathematics standard curriculum
	MTH.K401.L			Mathematical Science Special Exercises A	0-1-0	GA0M	(g)	
	MTH.K402.L			Mathematical Science Special Exercises B	0-1-0	GA0M	(g)	
	MTH.K403.L			Mathematical Science Special Exercises C	0-1-0	GA0M	(g)	
	MTH.K404.L			Mathematical Science Special Exercises D	0-1-0	GA0M	(g)	
	MTH.K405.L			Mathematical Science Internship MA	0-1-0	GA1M	(g)	
	MTH.K501.L			Special Career Program of Mathematical Science	0-1-0	GA1M	(g)	
	MTH.K502.L			Mathematical Science Internship MB	0-1-0	GA1M	(g)	

Entrepreneurship Courses	MTH.L501.L			Master's Recurrent Program 1-1 (Mathematics)	0-0-1	GA0 M GA1 M	(g)	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
	MTH.L502.L			Master's Recurrent Program 1-2 (Mathematics)	0-0-1	GA0 M GA1 M	(g)	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
	MTH.L503.L			Master's Recurrent Program 2 (Mathematics)	0-0-2	GA0 M GA1 M	(g)	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide. **＊GA: Graduate Attributes**								

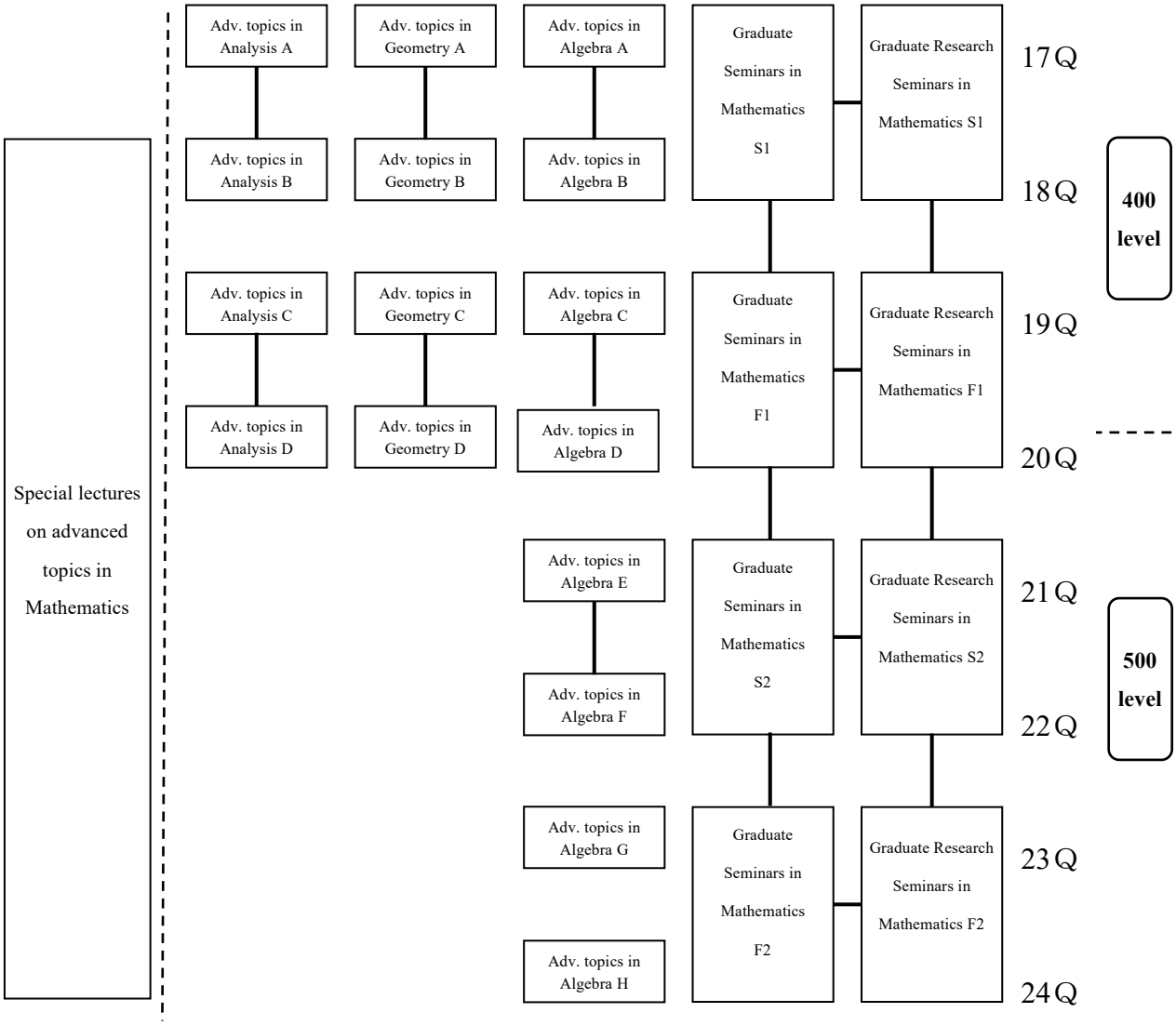
The Tokyo Tech Academy for Leadership (ToTAL), WISE Programs, or Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the academy or center that offers the relevant program.

8. Overview of Curriculum System



9. Example of a Standard Curriculum

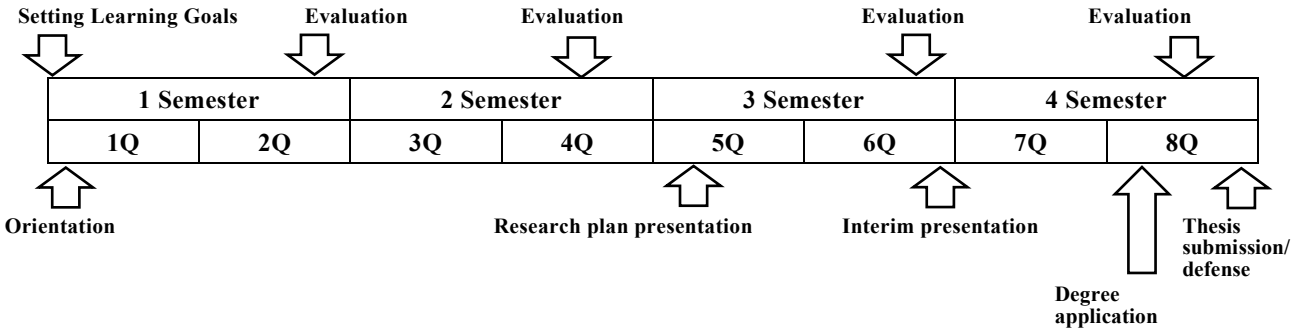
※ Students should take- multiple 400-level subjects from Advanced topics in Algebra, Geometry, and Analysis.



10. Research Related to the Completion of Master Theses

The students will conduct research related to the completion of Master's Theses according to the following procedure:

1. Understand the current status of their research subjects.
2. Find a specific open problem in their subjects.
3. Study the problem from different perspectives and try to find a solution.
4. Complete a Master's thesis on the background of the problem and the results they have obtained.
5. Make a presentation on their results at the master's thesis defense.



Examination criteria for the Master's thesis

Following requirements must be met.

1. The master's thesis provides a new result, perspective, or explanation of the research subject.
2. The master's thesis and defense guarantee the applicant's adequate understanding of his/her result and its significance.

The thesis review procedure

The review committee consists of at least three members. The final judgment is carried out after reviewing the thesis and the presentation by the candidate. The examination for candidates who enter the PhD course is made by at least five faculty members.

【Doctoral Degree Program】

1. Outline

The program aims to develop researchers who explore the frontiers of modern mathematics, and active professionals with highly-trained mathematical abilities for companies or government and municipal offices.

2. Competencies Developed

The students are expected to acquire

- Advanced theories and related subjects in mathematics, based on what they have learned and obtained in the Master's Degree Program.
- Skills to choose a specific problem in their own subjects and to obtain a new academic result.

3. Learning Goals

Through this program, the students are expected to:

A. Acquire theories and calculations in their subjects required for the progress of their research.
B. Understand the background and the current status of a topic/topics in a developing research subject/subjects.
C. Read fundamental references (textbooks or research papers) in their subjects thoroughly; also to re-construct what they have learned in their own words.
D. Write an academic paper on what they have learned and obtained during Graduate Seminars and Graduate Research Seminars.
E. Acquire necessary scientific culture by taking certain Humanities and Social Science Courses.
F. Be aware of their connections to society, professions, and careers, and acquire competencies to play an active part in business and industry.

4. IGP Completion Requirements

The following requirements must be met to complete the Doctoral Degree Program of the physics course.

1. Attain a total of 24 credits or more from 600-level courses according to the requirements in Table D1.
2. Pass the doctoral thesis review and defense.

Table D1 shows course categories and the number of credits required to complete the Doctoral Degree Program of this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as "associated learning goals". Prior to registering courses, students need to fully understand the course goals.

Table D1. Graduate Major in Mathematics Completion Requirements

<table>
<tr><th colspan="2">Course category</th><th><Required courses>
Required credits</th><th><Electives>
Minimum credits required</th><th>Minimum credits required</th><th>Associated learning goals</th><th>Comments</th></tr>
<tr><td rowspan="3">Liberal arts and basic science courses</td><td>Humanities and social science courses</td><td></td><td>2 credits</td><td rowspan="3">6 credits</td><td>E</td><td></td></tr>
<tr><td>Entrepreneurship courses</td><td></td><td>4 credits</td><td>F</td><td>All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)</td></tr>
<tr><td>Other courses</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Core courses</td><td>Research seminars</td><td>12 credits</td><td></td><td rowspan="3">18 credits</td><td>C,D</td><td></td></tr>
<tr><td>Research-related courses</td><td></td><td>4 credits</td><td>C,D</td><td></td></tr>
<tr><td>Major courses</td><td></td><td>2 credits</td><td>B</td><td></td></tr>
<tr><td>Major courses and Research-related courses <u>outside</u> the Graduate Major in Mathematics standard curriculum</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Total required credits</td><td colspan="5">A minimum of 24 credits including those attained according to the above conditions</td></tr>
<tr><td colspan="2">Note</td><td colspan="5">・Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level.
・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.</td></tr>
</table>

5. IGP Courses

Table D2 shows the Core Courses of the Doctoral Degree Program of this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

Table D2. Core Courses of the Graduate Major in Mathematics

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	600 level	MTH.Z691.R	◎	★	Graduate Seminars in Mathematics S3	0-2-0	1,3,4,5	C	
		MTH.Z692.R	◎	★	Graduate Seminars in Mathematics F3	0-2-0	1,3,4,5	C	
		MTH.Z693.R	◎	★	Graduate Seminars in Mathematics S4	0-2-0	1,3,4,5	C	
		MTH.Z694.R	◎	★	Graduate Seminars in Mathematics F4	0-2-0	1,3,4,5	C	
		MTH.Z695.R	◎	★	Graduate Seminars in Mathematics S5	0-2-0	1,3,4,5	C	
		MTH.Z696.R	◎	★	Graduate Seminars in Mathematics F5	0-2-0	1,3,4,5	C	
Research-related courses	600 level	MTH.R691.A	A ○	★	Graduate Research Seminars in Mathematics S3	0-2-0	1,3,4,5	C	
		MTH.R692.A	A ○	★	Graduate Research Seminars in Mathematics F3	0-2-0	1,3,4,5	C	
		MTH.R693.A	A ○	★	Graduate Research Seminars in Mathematics S4	0-2-0	1,3,4,5	C	
		MTH.R694.A	A ○	★	Graduate Research Seminars in Mathematics F4	0-2-0	1,3,4,5	C	
		MTH.R695.A	A ○	★	Graduate Research Seminars in Mathematics S5	0-2-0	1,3,4,5	C	
		MTH.R696.A	A ○	★	Graduate Research Seminars in Mathematics F5	0-2-0	1,3,4,5	C	
Major courses	600 level	MTH.E631.A	A ○		Special lectures on current topics in Mathematics A	2-0-0	1	B	**Not available in AY 2024**
		MTH.E632.A	A ○		Special lectures on current topics in Mathematics B	2-0-0	1	B	**Not available in AY 2024**
		MTH.E633.A	A ○		Special lectures on current topics in Mathematics C	2-0-0	1	B	**Not available in AY 2024**
		MTH.E634.A	A ○		Special lectures on current topics in Mathematics D	2-0-0	1	B	**Not available in AY 2024**
		MTH.E635.A	A ○		Special lectures on current topics in Mathematics E	2-0-0	1	B	**Not available in AY 2024**
		MTH.E636.A	A ○		Special lectures on current topics in Mathematics F	2-0-0	1	B	**Not available in AY 2024**

		MTH.E637.A	A ○		Special lectures on current topics in Mathematics G	2-0-0	1	B	**Not available in AY 2024**
		MTH.E638.A	A ○		Special lectures on current topics in Mathematics H	2-0-0	1	B	**Not available in AY 2024**
		MTH.E639.A	A ○		Special lectures on current topics in Mathematics I	2-0-0	1	B	**Not available in AY 2024**
		MTH.E640.A	A ○		Special lectures on current topics in Mathematics J	2-0-0	1	B	**Not available in AY 2024**
		MTH.E641.A	A ○		Special lectures on current topics in Mathematics K	2-0-0	1	B	**Not available in AY 2024**
		MTH.E642.A	A ○		Special lectures on current topics in Mathematics L	2-0-0	1	B	**Not available in AY 2024**
		MTH.E643.A	A ○		Special lectures on current topics in Mathematics M	2-0-0	1	B	
		MTH.E644.A	A ○		Special lectures on current topics in Mathematics N	2-0-0	1	B	
		MTH.E645.A	A ○		Special lectures on current topics in Mathematics P	2-0-0	1	B	
		MTH.E646.A	A ○		Special lectures on current topics in Mathematics Q	2-0-0	1	B	
		MTH.E647.A	A ○		Special lectures on current topics in Mathematics R	2-0-0	1	B	
		MTH.E648.A	A ○	★	Special lectures on current topics in Mathematics S	2-0-0	1	B	
		MTH.E654.A	A ○		Special lectures on current topics in Mathematics W	2-0-0	1	B	
		MTH.E657.L		★	Lecture on Science in English (Mathematics 5)	1-0-0	1	B	**Not available in AY 2024**
		MTH.E658.L		★	Lecture on Science in English (Mathematics6)	0-0-1	1	B	**Not available in AY 2024**
		MTH.K601.L			Mathematical Science Career Development A	0-1-0	3,4,5	F	
		MTH.K602.L			Mathematical Science Career Development B	0-1-0	3,4,5	F	
		MTH.K603.L			Mathematical Science Career Development C	0-1-0	3,4,5	F	
		MTH.K604.L			Mathematical Science Career Development D	0-1-0	3,4,5	F	
		MTH.K605.L			Mathematical Science Tutorial A	0-1-0	3,4,5	F	
		MTH.K606.L			Mathematical Science Tutorial B	0-1-0	3,4,5	F	
		MTH.K607.L			Mathematical Science Tutorial C	0-1-0	3,4,5	F	

		MTH.K608.L			Mathematical Science Tutorial D	0-1-0	3,4,5	F	
		MTH.K609.L		★	Advanced Career Program of Mathematical Science	0-1-0	3,4,5	F	
		MTH.K610.L			Mathematical Science Internship DA	0-1-0	5	F	
		MTH.K611.L			Mathematical Science Internship DB	0-1-0	5	F	
		MTH.K620.L			Cooperative Education through Research Internships of Mathematics	0-0-4	1,3,4,5	F	

Note：

• ◎：Required course, ○：Restricted elective, ★：Classes in English

• Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)

• The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ABC.D600.R): A: Algebra, B: Geometry, C: Analysis, D: Courses on practical aspects in Mathematical Finance, Z: Research Seminars

6. IGP Courses That Can Be Counted as Humanities and Social Science Courses

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least four credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table D-1 of the “Entrepreneurship Courses” listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table D3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program.

As there are some Entrepreneurship Courses without GAs, please check carefully before registering for them.

However, it must be noted that credits attained from courses that are recognized as Entrepreneurship Courses can be counted towards the completion requirements of the doctoral degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.
The Graduate Attributes of the Doctoral Degree Program are listed in Table D-1 as follows:

GA0D: You can clearly design your own career and contribute to realizing scientific, technological, or social innovation through a comprehensive understanding of the knowledge, skills, social responsibilities and ethics required to become an active member of academia and/or industry.

GA1D: You can lead in realizing scientific, technological, or social innovation by acquiring advanced leadership skills, entrepreneurship, knowledge and expertise, and by developing social responsibility necessary for materializing your designed career.

Table D3. Courses of the Graduate Major in Mathematics recognized as equivalent to Entrepreneurship Courses, and Entrepreneurship Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	XIP.A601		★	Advanced International Practice in Science	1-0-0	GA1D		Common Course of School of Science Outside the Graduate Major in Mathematics standard curriculum
	MTH.K601.L			Mathematical Science Career Development A	0-1-0	GA0D	F	
	MTH.K602.L			Mathematical Science Career Development B	0-1-0	GA0D	F	
	MTH.K603.L			Mathematical Science Career Development C	0-1-0	GA0D	F	
	MTH.K604.L			Mathematical Science Career Development D	0-1-0	GA0D	F	
	MTH.K605.L			Mathematical Science Tutorial A	0-1-0	GA1D	F	
	MTH.K606.L			Mathematical Science Tutorial B	0-1-0	GA1D	F	
	MTH.K607.L			Mathematical Science Tutorial C	0-1-0	GA1D	F	
	MTH.K608.L			Mathematical Science Tutorial D	0-1-0	GA1D	F	
	MTH.K609.L		★	Advanced Career Program of Mathematical Science	0-1-0	GA1D	F	
	MTH.K610.L			Mathematical Science Internship DA	0-1-0	GA1D	F	
	MTH.K611.L			Mathematical Science Internship DB	0-1-0	GA1D	F	
	MTH.K620.L			Cooperative Education through Research Internships of Mathematics	0-0-4	GA1D	F	

Entrepreneurship Courses	MTH.L601.L			Doctoral Recurrent Program 1 (Mathematics)	0-0-1	GA0 D GA1 D	F	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
	MTH.L602.L			Doctoral Recurrent Program 2-1 (Mathematics)	0-0-2	GA0 D GA1 D	F	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
	MTH.L603.L			Doctoral Recurrent Program 2-2 (Mathematics)	0-0-2	GA0 D GA1 D	F	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
	MTH.L604.L			Doctoral Recurrent Program 3 (Mathematics)	0-0-3	GA0 D GA1 D	F	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)
	MTH.L605.L			Doctoral Recurrent Program 4 (Mathematics)	0-0-4	GA0 D GA1 D	F	Entrepreneurship Course offered by the Graduate Major in Mathematics. (Cannot be counted for Major Courses)

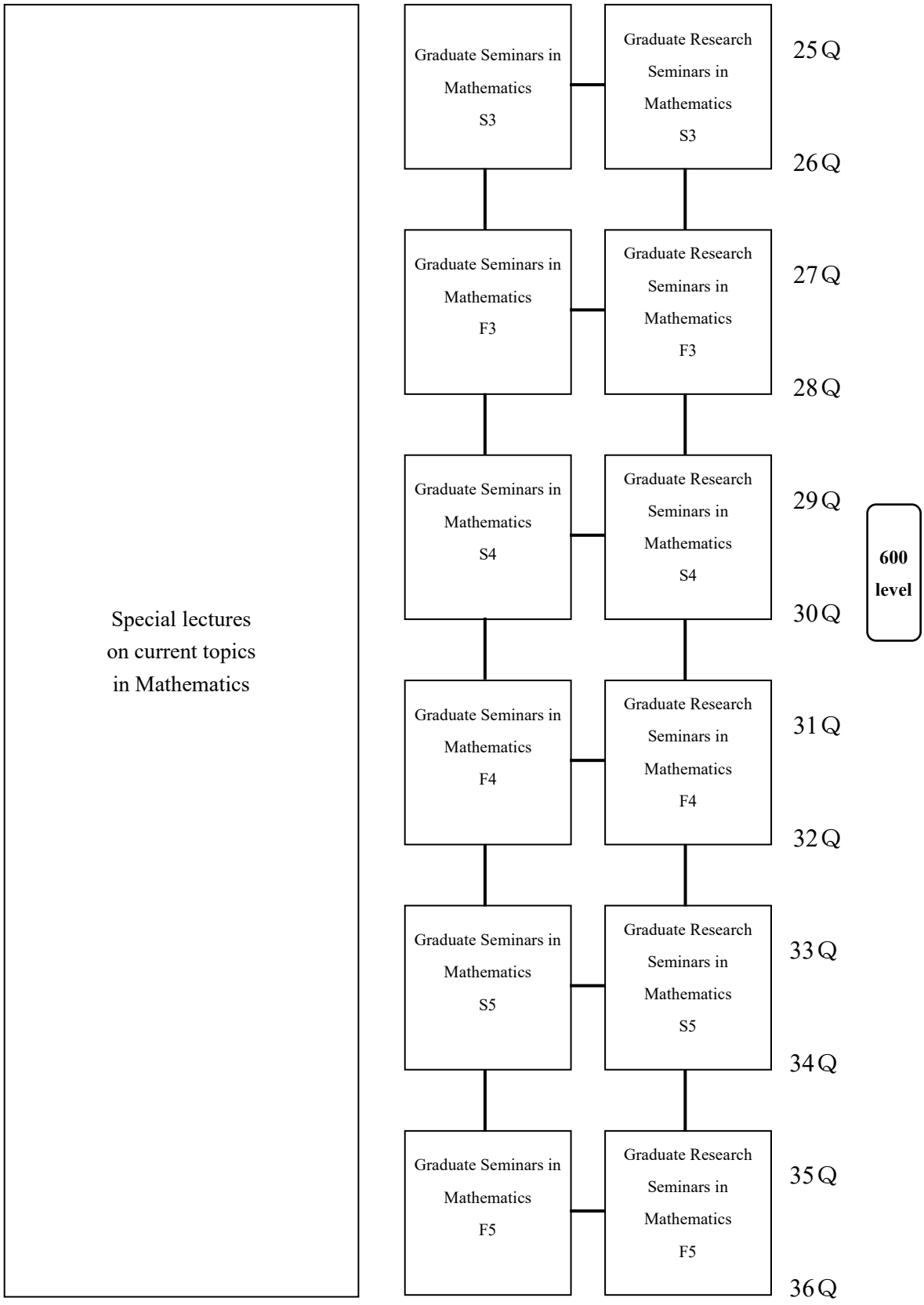
★: Classes in English

Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

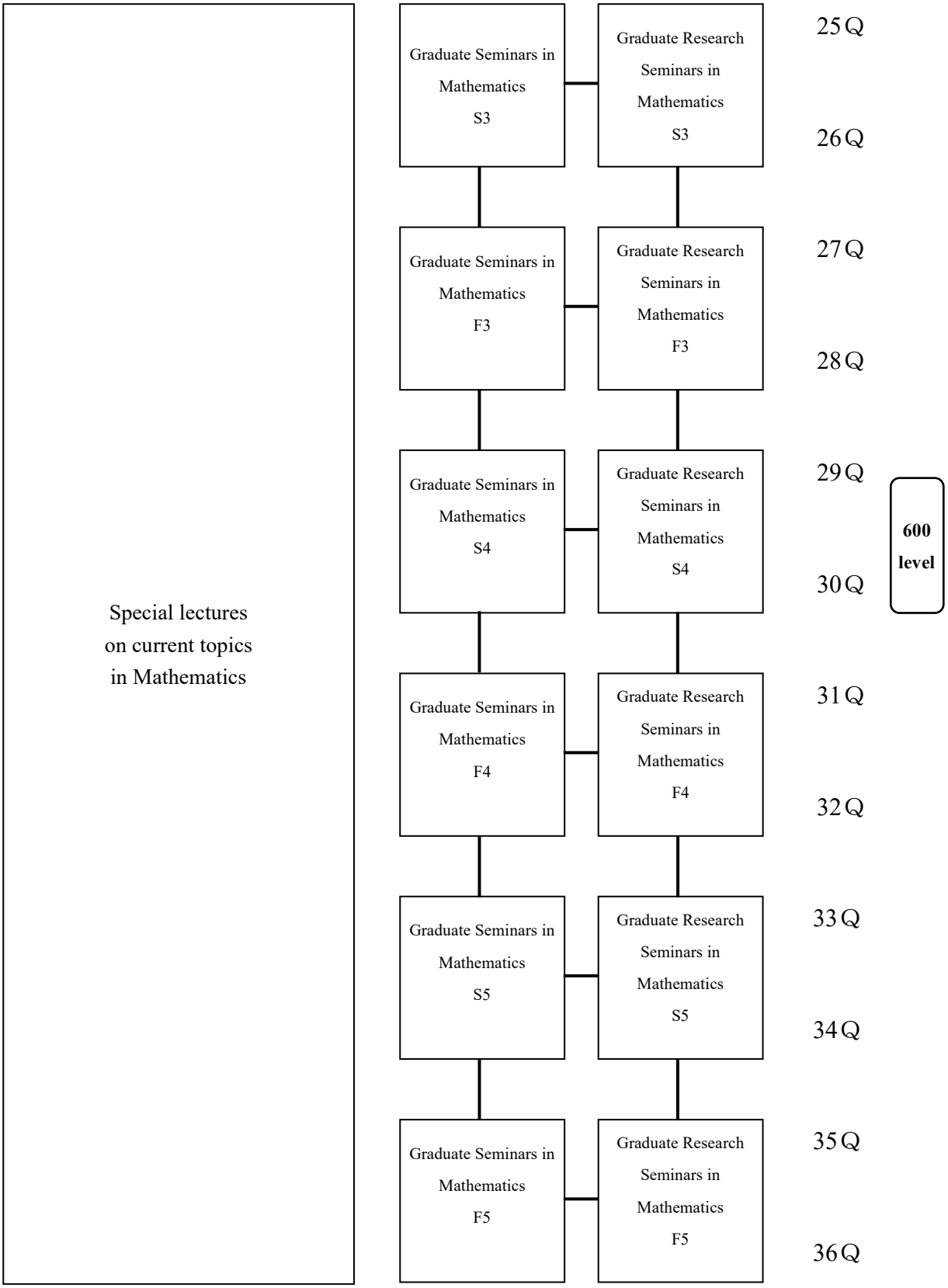
＊GA: Graduate Attributes

The Tokyo Tech Academy for Leadership (ToTAL), WISE Programs, or Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the academy or center that offers the relevant program.

8. Overview of Curriculum System



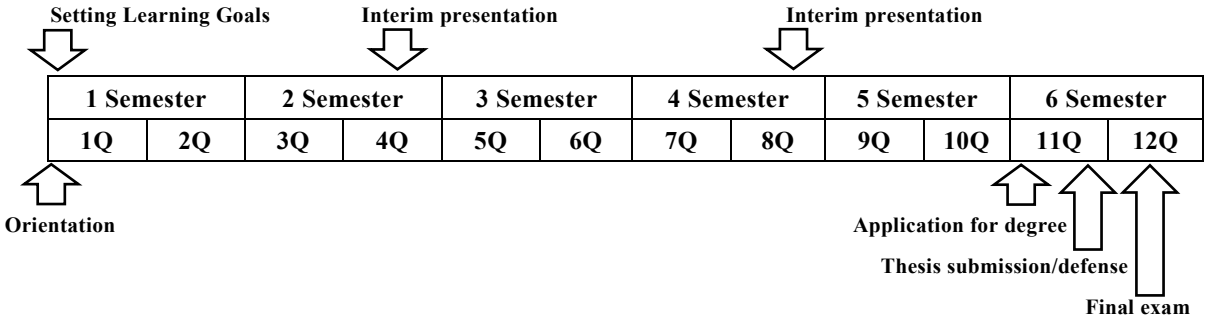
9. Example of a Standard Curriculum



10. Research Related to the Completion of Doctoral Theses

The students will conduct research related to the completion of Doctoral Theses according to the following procedure:

1. Understand the current status of their research subjects and related subjects.
2. Find a specific problem/problems to solve.
3. Study the problem/problems from different perspectives and try to find a solution/solutions.
4. Complete a Doctoral Thesis on the background of the problem/problems and the results they have obtained.
5. Make a presentation on their results at the defense.



The criteria for examination

Following requirements must be met for the qualification.

1. The thesis is of sufficient originality and it contributes progress in the research subject.
2. A paper article to which the candidate has a major contribution is published. (By “a paper article” we mean a research paper published in an international peer-reviewed journal.

The thesis review procedure

The review committee consists of at least five members. The final judgment is carried out after reviewing the thesis and the presentation by the candidate. In the final judgment, the committee will check the candidate’s comprehension of the subject.