Graduate Major in Mathematics

【Master's Degree Program】

1. Outline

Mathematics has been developed for thousands of years dealing with numbers, figures, functions, etc. It is a foundation of natural and social sciences and still developing itself. In this program students are expected to cultivate the abilities to explore the frontiers of the modern mathematics, and to acquire profound and professional knowledge in mathematics, as well as advanced logical thinking. The program is also aimed to develop highly-trained professionals who will contribute to our society, like teachers and engineers.

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 any 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 the 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 about what they have learned and obtained in their Graduate Seminars and Graduate Research Seminars.

(f) Acquire cultures that are necessary for students majoring science, by taking Humanities and Social Science Courses.

(g) Be aware of their connections to the society, professions, and careers, and to acquire competences 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)	
	Career development courses		2 credits		(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	2,3,4,5	(d)	
		MTH.Z492.R	◎	★	Graduate Seminars in Mathematics F1	0-2-0	2,3,4,5	(d)	
	500 level	MTH.Z591.R	◎	★	Graduate Seminars in Mathematics S2	0-2-0	2,3,4,5	(d)	
		MTH.Z592.R	◎	★	Graduate Seminars in Mathematics F2	0-2-0	2,3,4,5	(d)	
Research-related courses	**400 level**	MTH.R491.A	A ○	★	Graduate Research Seminars in Mathematics S1	0-2-0	2,3,4,5	(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	2,3,4,5	(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	2,3,4,5	(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	2,3,4,5	(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	3	(a)	Only for even academic years
		MTH.A402.A	A ○		Advanced topics in Algebra B	1-0-0	3	(a)	Only for even academic years
		MTH.A403.A	A ○	★	Advanced topics in Algebra C	1-0-0	3	(a)	Only for even academic years
		MTH.A404.A	A ○	★	Advanced topics in Algebra D	1-0-0	3	(a)	Only for even academic years
		MTH.A405.A	A ○		Advanced topics in Algebra A1	1-0-0	3	(a)	Only for odd academic years
		MTH.A406.A	A ○		Advanced topics in Algebra B1	1-0-0	3	(a)	Only for odd academic years
		MTH.A407.A	A ○		Advanced topics in Algebra C1	1-0-0	3	(a)	Only for odd academic years
		MTH.A408.A	A ○		Advanced topics in Algebra D1	1-0-0	3	(a)	Only for odd academic years
		MTH.B401.A	A ○		Advanced topics in Geometry A	1-0-0	3	(a)	Only for even academic years
		MTH.B402.A	A ○		Advanced topics in Geometry B	1-0-0	3	(a)	Only for even academic years
		MTH.B403.A	A ○		Advanced topics in Geometry C	1-0-0	3	(a)	Only for even academic years
		MTH.B404.A	A ○		Advanced topics in Geometry D	1-0-0	3	(a)	Only for even academic years
		MTH.B405.A	A ○		Advanced topics in Geometry A1	1-0-0	3	(a)	Only for odd academic years
		MTH.B406.A	A ○		Advanced topics in Geometry B1	1-0-0	3	(a)	Only for odd academic years
		MTH.B407.A	A ○		Advanced topics in Geometry C1	1-0-0	3	(a)	Only for odd academic years
		MTH.B408.A	A ○		Advanced topics in Geometry D1	1-0-0	3	(a)	Only for odd academic years
		MTH.C401.A	A ○		Advanced topics in Analysis A	1-0-0	3	(a)	Only for even academic years
		MTH.C402.A	A ○		Advanced topics in Analysis B	1-0-0	3	(a)	Only for even academic years

		MTH.C403.A	A ○		Advanced topics in Analysis C	1-0-0	3	(a)	Only for even academic years
		MTH.C404.A	A ○		Advanced topics in Analysis D	1-0-0	3	(a)	Only for even academic years
		MTH.C405.A	A ○		Advanced topics in Analysis A1	1-0-0	3	(a)	Only for odd academic years
		MTH.C406.A	A ○		Advanced topics in Analysis B1	1-0-0	3	(a)	Only for odd academic years
		MTH.C407.A	A ○		Advanced topics in Analysis C1	1-0-0	3	(a)	Only for odd academic years
		MTH.C408.A	A ○		Advanced topics in Analysis D1	1-0-0	3	(a)	Only for odd academic years
		MTH.D401			Advanced Topics in Mathematical Finance A	1-0-0	3	(c) (f)	Outside the standard curriculum
		MTH.D402			Advanced Topics in Mathematical Finance B	1-0-0	3	(c) (f)	Outside the standard curriculum
		MTH.D403			Advanced Topics in Mathematical Finance C	1-0-0	3	(c) (f)	Outside the standard curriculum
		MTH.D404			Advanced Topics in Mathematical Finance D	1-0-0	3	(c) (f)	Outside the standard curriculum
		MTH.E431.A	A ○		Special lectures on advanced topics in Mathematics A	2-0-0	3	(d)	Only for even academic years
		MTH.E432.A	A ○		Special lectures on advanced topics in Mathematics B	2-0-0	3	(d)	Only for even academic years
		MTH.E433.A	A ○		Special lectures on advanced topics in Mathematics C	2-0-0	3	(d)	Only for even academic years
		MTH.E434.A	A ○		Special lectures on advanced topics in Mathematics D	2-0-0	3,5	(d)	Only for even academic years
		MTH.E435.A	A ○		Special lectures on advanced topics in Mathematics E	2-0-0	3	(d)	Only for even academic years
		MTH.E436.A	A ○		Special lectures on advanced topics in Mathematics F	2-0-0	3	(d)	Only for even academic years
		MTH.E437.A	A ○		Special lectures on advanced topics in Mathematics M	2-0-0	3	(d)	Only for even academic years **Not available in AY 2018**
		MTH.E438.A	A ○		Special lectures on advanced topics in Mathematics N	2-0-0	3	(d)	Only for even academic years **Not available in AY 2018**
		MTH.E439.A	A ○		Special lectures on advanced topics in Mathematics P	2-0-0	3	(d)	Only for even academic years **Not available in AY 2018**

		MTH.E440.A	A ○		Special lectures on advanced topics in Mathematics Q	2-0-0	3	(d)	
		MTH.E441.L		★	Special Lecture on Science in English (Mathematics 3)	1-0-0	3		**Not available in AY 2018**
		MTH.E442.L		★	Special Lecture on Science in English (Mathematics 4)	1-0-0	3		
		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)	
	500 level	MTH.A501.A	A ○	★	Advanced topics in Algebra E	1-0-0	3	(b)	Only for even academic years
		MTH.A502.A	A ○	★	Advanced topics in Algebra F	1-0-0	3	(b)	Only for even academic years
		MTH.A503.A	A ○	★	Advanced topics in Algebra G	1-0-0	3	(b)	Only for even academic years
		MTH.A504.A	A ○	★	Advanced topics in Algebra H	1-0-0	3	(b)	Only for even academic years
		MTH.A505.A	A ○		Advanced topics in Algebra E1	1-0-0	3	(b)	Only for odd academic years
		MTH.A506.A	A ○		Advanced topics in Algebra F1	1-0-0	3	(b)	Only for odd academic years
		MTH.A507.A	A ○		Advanced topics in Algebra G1	1-0-0	3	(b)	Only for odd academic years
		MTH.A508.A	A ○		Advanced topics in Algebra H1	1-0-0	3	(b)	Only for odd academic years
		MTH.B501.A	A ○		Advanced topics in Geometry E	1-0-0	3	(b)	Only for even academic years
		MTH.B502.A	A ○		Advanced topics in Geometry F	1-0-0	3	(b)	Only for even academic years
		MTH.B503.A	A ○		Advanced topics in Geometry G	1-0-0	3	(b)	Only for even academic years
		MTH.B504.A	A ○		Advanced topics in Geometry H	1-0-0	3,5	(b)	Only for even academic years
		MTH.B505.A	A ○		Advanced topics in Geometry E1	1-0-0	3	(b)	Only for odd academic years
		MTH.B506.A	A ○		Advanced topics in Geometry F1	1-0-0	3	(b)	Only for odd academic years
		MTH.B507.A	A ○		Advanced topics in Geometry G1	1-0-0	3	(b)	Only for odd academic years

		MTH.B508.A	A ○		Advanced topics in Geometry H1	1-0-0	3	(b)	Only for odd academic years
		MTH.C501.A	A ○		Advanced topics in Analysis E	1-0-0	3	(b)	Only for even academic years
		MTH.C502.A	A ○		Advanced topics in Analysis F	1-0-0	3	(b)	Only for even academic years
		MTH.C503.A	A ○		Advanced topics in Analysis G	1-0-0	3	(b)	Only for even academic years
		MTH.C504.A	A ○		Advanced topics in Analysis H	1-0-0	3	(b)	Only for even academic years
		MTH.C505.A	A ○		Advanced topics in Analysis E1	1-0-0	3	(b)	Only for odd academic years
		MTH.C506.A	A ○		Advanced topics in Analysis F1	1-0-0	3	(b)	Only for odd academic years
		MTH.C507.A	A ○		Advanced topics in Analysis G1	1-0-0	3	(b)	Only for odd academic years
		MTH.C508.A	A ○		Advanced topics in Analysis H1	1-0-0	3	(b)	Only for odd academic years
		MTH.E531.A	A ○		Special lectures on advanced topics in Mathematics G	2-0-0	3	(d)	Only for odd academic years
		MTH.E532.A	A ○		Special lectures on advanced topics in Mathematics H	2-0-0	3	(d)	Only for odd academic years
		MTH.E533.A	A ○		Special lectures on advanced topics in Mathematics I	2-0-0	3	(d)	Only for odd academic years
		MTH.E534.A	A ○		Special lectures on advanced topics in Mathematics J	2-0-0	3	(d)	Only for odd academic years
		MTH.E535.A	A ○		Special lectures on advanced topics in Mathematics K	2-0-0	3	(d)	Only for odd academic years
		MTH.E536.A	A ○		Special lectures on advanced topics in Mathematics L	2-0-0	3	(d)	Only for odd academic years
		MTH.K501.L			Special Career Program of Mathematical Science	0-1-0	2,5	(g)	

Note：

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

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = 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 Courses That Can Be Counted as Career Development Courses

In order to fulfill the completion requirements for the master's degree program, students must attain at least 2 credits in Career Development Courses, and should satisfy all of the Graduate Attributes (GA) specified in Table MA-1 of the "Career Development Courses" (Liberal Arts and Basic Science Courses) in the Guide to Graduate Education and International Graduate Program. Students will be evaluated in regards to GA achievements at the time of their degree completion. As to the courses with more than one GA, the number of GA stipulated for the courses is considered to be acquired regardless of the credits received for the courses.

Major Courses that enable students to acquire GA and that are recognized as equivalent to Career Development Courses are listed in Table M3 below.

However, it must be noted that credits attained from these courses cannot be counted more than once as Major Courses or Career Development Courses towards the completion requirements for the master's degree program.

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

C0M: Able to delineate one's career plan clearly and recognize the skills necessary to materialize the plan, also considering its relations to the society

C1M: Able to utilize its own expertise to the development of academia and technology, and work with others with different expertise to contribute to problem-solving

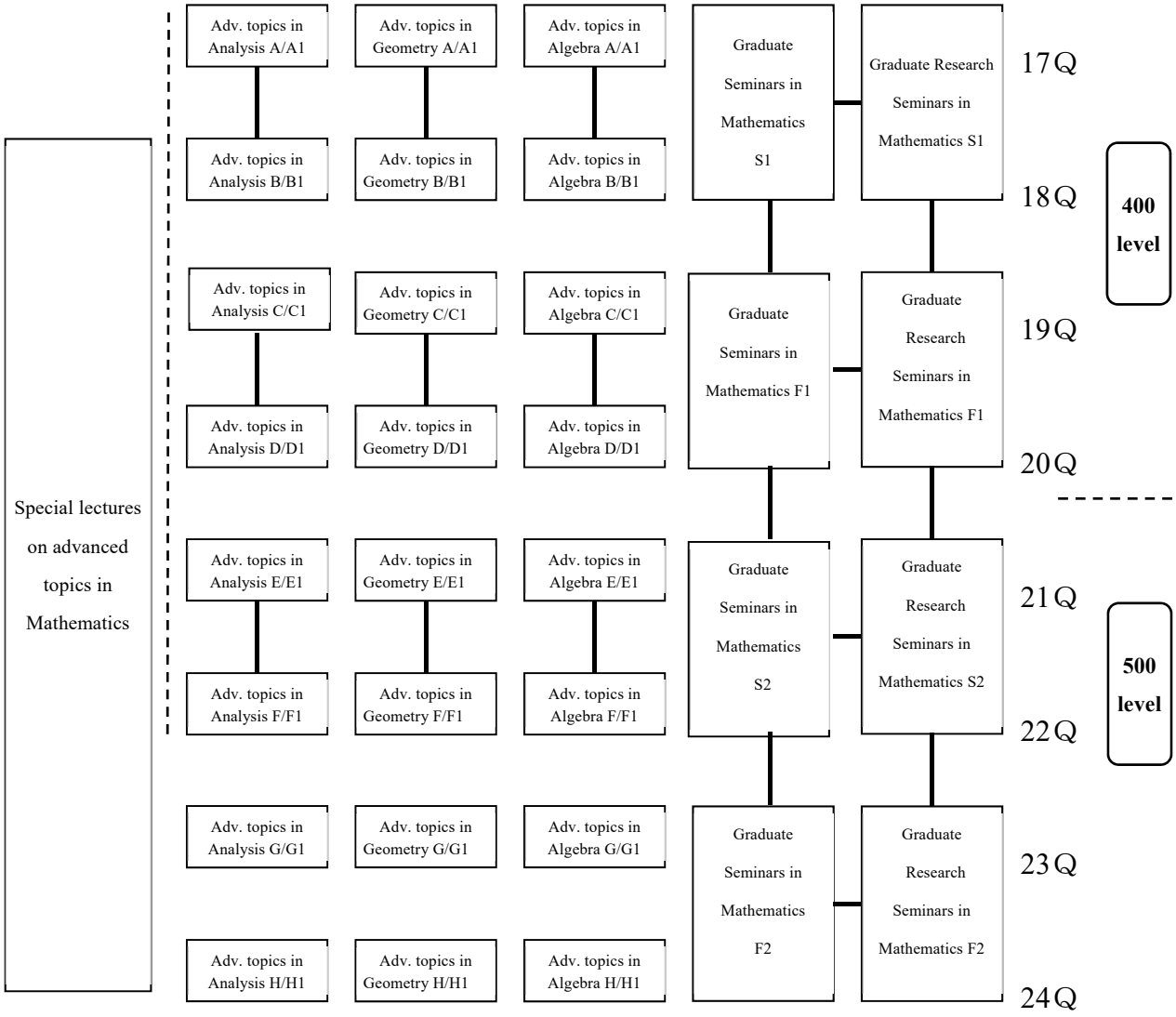
Table M3. Courses of the Graduate Major in Mathematics recognized as equivalent to Career Development Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	XIP.A401		★	Special International Practice in Science	0-2-0	C1M		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	C0M	(g)	
	MTH.K402.L			Mathematical Science Special Exercises B	0-1-0	C0M	(g)	
	MTH.K403.L			Mathematical Science Special Exercises C	0-1-0	C0M	(g)	
	MTH.K404.L			Mathematical Science Special Exercises D	0-1-0	C0M	(g)	
	MTH.K501.L			Special Career Program of Mathematical Science	0-1-0	C1M	(g)	

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

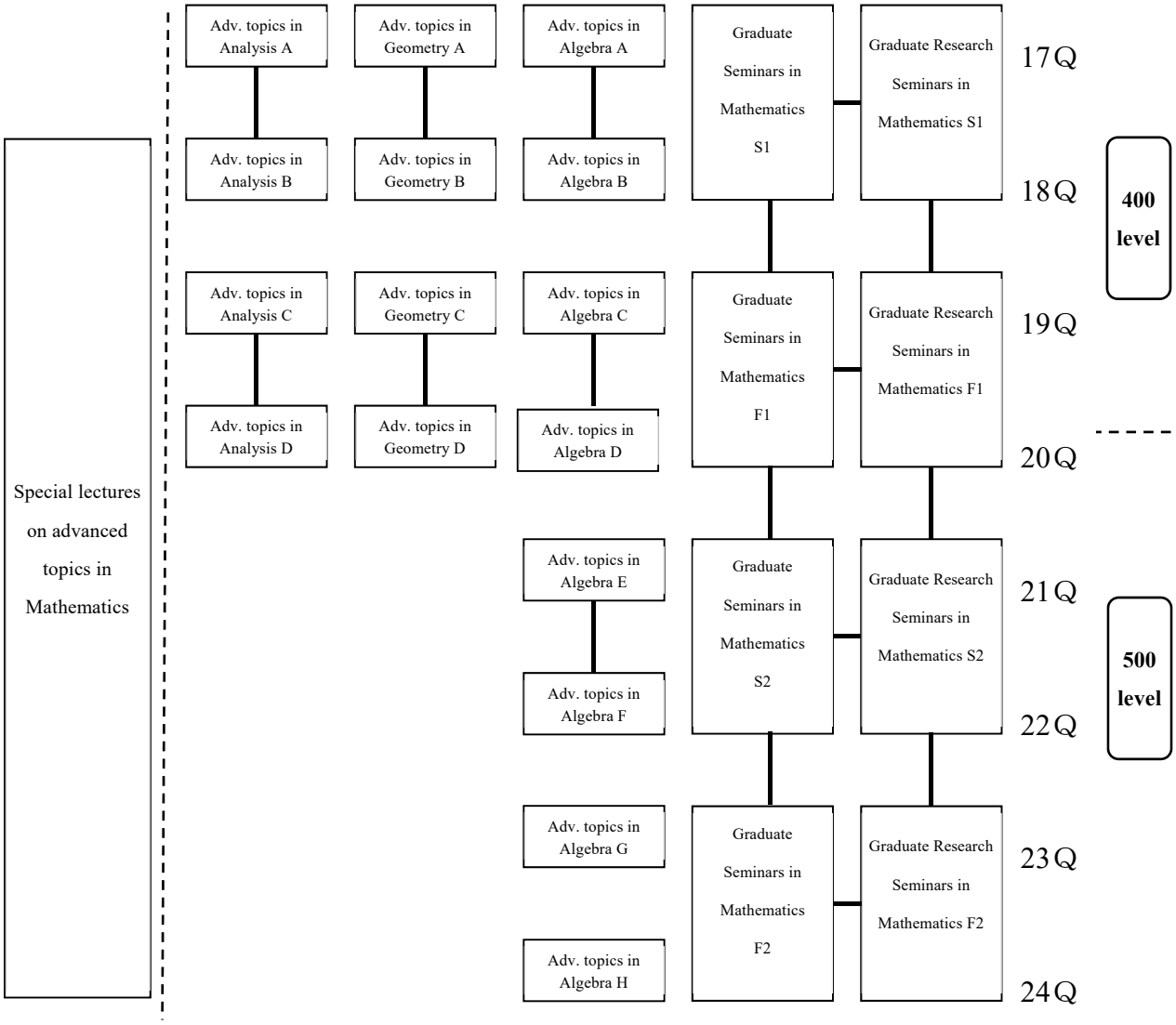
＊GA: Graduate Attributes

8. Overview of Curriculum System



9. Example of a Standard Curriculum

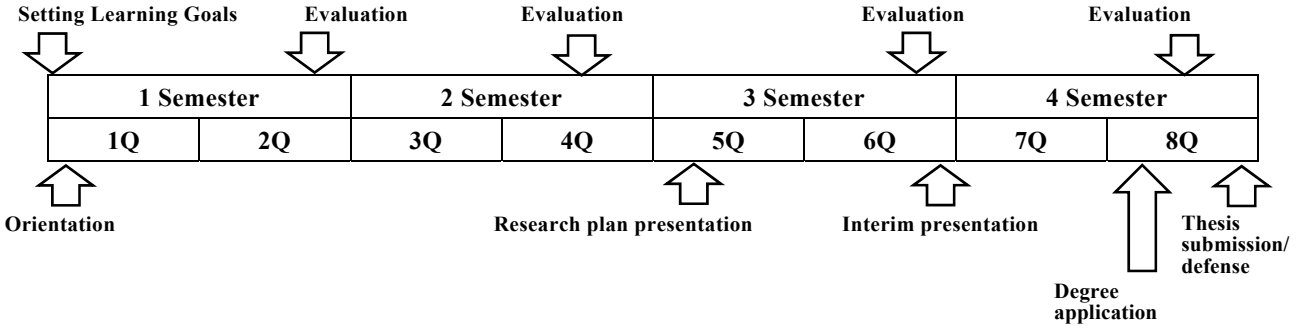
※ Students should take multiple subjects from Advanced topics in Algebra, Geometry, and Analysis in 400 level.



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 in the research subject.
2. The master's thesis and defense guarantee the applicant's adequate understanding about 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 candidate who enters the PhD course is made by at least five faculty members.

【Doctoral Degree Program】

1. Outline

The program is aimed to develop researchers who explore the frontiers of the modern mathematics, and active professionals with highly-trained mathematical ability in 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 about what they have learned and obtained in their Graduate Seminars and Graduate Research Seminars.
E. Acquire culture that are necessary for students majoring science, by taking Humanities and Social Science Courses.
F. Be aware of their connections to the society, professions, and careers, and to acquire competences 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

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	6 credits	E	
	Career development courses		4 credits		F	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	12 credits		18 credits	C,D	
	Research-related courses		4 credits		C,D	
	Major courses		2 credits		B	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Mathematics standard curriculum					
Total required credits		A minimum of 24 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 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	2,3,4,5	C	
		MTH.Z692.R	◎	★	Graduate Seminars in Mathematics F3	0-2-0	2,3,4,5	C	
		MTH.Z693.R	◎	★	Graduate Seminars in Mathematics S4	0-2-0	2,3,4,5	C	
		MTH.Z694.R	◎	★	Graduate Seminars in Mathematics F4	0-2-0	2,3,4,5	C	
		MTH.Z695.R	◎	★	Graduate Seminars in Mathematics S5	0-2-0	2,3,4,5	C	
		MTH.Z696.R	◎	★	Graduate Seminars in Mathematics F5	0-2-0	2,3,4,5	C	
Research-related courses	600 level	MTH.R691.A	A ○	★	Graduate Research Seminars in Mathematics S3	0-2-0	2,3,4,5	C	
		MTH.R692.A	A ○	★	Graduate Research Seminars in Mathematics F3	0-2-0	2,3,4,5	C	
		MTH.R693.A	A ○	★	Graduate Research Seminars in Mathematics S4	0-2-0	2,3,4,5	C	
		MTH.R694.A	A ○	★	Graduate Research Seminars in Mathematics F4	0-2-0	2,3,4,5	C	
		MTH.R695.A	A ○	★	Graduate Research Seminars in Mathematics S5	0-2-0	2,3,4,5	C	
		MTH.R696.A	A ○	★	Graduate Research Seminars in Mathematics F5	0-2-0	2,3,4,5	C	
Major courses	600 level	MTH.E631.A	A ○		Special lectures on current topics in Mathematics A	2-0-0	3	B	**Not available in AY 2018**
		MTH.E632.A	A ○		Special lectures on current topics in Mathematics B	2-0-0	3	B	**Not available in AY 2018**
		MTH.E633.A	A ○		Special lectures on current topics in Mathematics C	2-0-0	3	B	**Not available in AY 2018**
		MTH.E634.A	A ○		Special lectures on current topics in Mathematics D	2-0-0	3,5	B	**Not available in AY 2018**
		MTH.E635.A	A ○		Special lectures on current topics in Mathematics E	2-0-0	3	B	**Not available in AY 2018**

		MTH.E636.A	A ○		Special lectures on current topics in Mathematics F	2-0-0	3	B	**Not available in AY 2018**
		MTH.E637.A	A ○		Special lectures on current topics in Mathematics G	2-0-0	3	B	**Not available in AY 2018**
		MTH.E638.A	A ○		Special lectures on current topics in Mathematics H	2-0-0	3	B	**Not available in AY 2018**
		MTH.E639.A	A ○		Special lectures on current topics in Mathematics I	2-0-0	3	B	**Not available in AY 2018**
		MTH.E640.A	A ○		Special lectures on current topics in Mathematics J	2-0-0	3	B	**Not available in AY 2018**
		MTH.E641.A	A ○		Special lectures on current topics in Mathematics K	2-0-0	3	B	**Not available in AY 2018**
		MTH.E642.A	A ○		Special lectures on current topics in Mathematics L	2-0-0	3	B	**Not available in AY 2018**
		MTH.E643.A	A ○		Special lectures on current topics in Mathematics M	2-0-0	3	B	
		MTH.E644.A	A ○		Special lectures on current topics in Mathematics N	2-0-0	3	B	
		MTH.E645.A	A ○		Special lectures on current topics in Mathematics P	2-0-0	3	B	
		MTH.E646.A	A ○		Special lectures on current topics in Mathematics Q	2-0-0	3	B	
		MTH.E647.A	A ○		Special lectures on current topics in Mathematics R	2-0-0	3	B	
		MTH.E648.A	A ○		Special lectures on current topics in Mathematics S	2-0-0	3	B	
		MTH.E651.A	A ○		Special lectures on current topics in Mathematics T	2-0-0	3	B	**Not available in AY 2018**
		MTH.E652.A	A ○		Special lectures on current topics in Mathematics U	2-0-0	3	B	**Not available in AY 2018**
		MTH.E653.A	A ○		Special lectures on current topics in Mathematics V	2-0-0	3	B	**Not available in AY 2018**
		MTH.E654.A	A ○		Special lectures on current topics in Mathematics W	2-0-0	3	B	
		MTH.E655.L		★	Lecture on Science in English (Mathematics 3)	1-0-0	3		**Not available in AY 2018**
		MTH.E656.L		★	Lecture on Science in English (Mathematics 4)	1-0-0	3		
		MTH.K601.L			Mathematical Science Career Development A	0-1-0	2,4,5	F	
		MTH.K602.L			Mathematical Science Career Development B	0-1-0	2,4,5	F	
		MTH.K603.L			Mathematical Science Career Development C	0-1-0	2,4,5	F	

		MTH.K604.L			Mathematical Science Career Development D	0-1-0	2,4,5	F	
		MTH.K605.L			Mathematical Science Tutorial A	0-1-0	2,4,5	F	
		MTH.K606.L			Mathematical Science Tutorial B	0-1-0	2,4,5	F	
		MTH.K607.L			Mathematical Science Tutorial C	0-1-0	2,4,5	F	
		MTH.K608.L			Mathematical Science Tutorial D	0-1-0	2,4,5	F	
		MTH.K609.L			Advanced Career Program of Mathematical Science	0-1-0	2,5	F	

Note：

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

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = 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 Courses That Can Be Counted as Career Development Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least 4 credits in Career Development Courses, and should satisfy all of the Graduate Attributes (GA) specified in Table A-1 or A-2 of the “Career Development Courses” (Liberal Arts and Basic Science Courses) in the Guide to Graduate Education and International Graduate Program. Students will be evaluated in regards to GA achievements at the time of their degree completion. As to the courses with more than one GA, the number of GA stipulated for the courses is considered to be acquired regardless of the credits received for the courses.

Major Courses that enable students to acquire GA and that are recognized as equivalent to Career Development Courses are listed in Tables D3-1 and D3-2 below.

However, it must be noted that credits attained from these courses cannot be counted more than once as Major Courses or Career Development Courses towards the completion requirements for the doctoral degree program.

For Graduate Attributes, refer to the Guide to the Career Development Courses.
The Graduate Attributes of the Academic Leader Program (ALP) are listed in Table A-1 as follows:

A0D: You will be able to precisely draw your own career plan and self-train yourself to acquire the skills required for attaining your goals in the academic field

A1D: You will be able to ascertain the true nature of phenomena, master the secret of learning, and lead the pioneering of a new academic discipline or research area

A2D: You will be able to understand the position of academia in society, and adequately explain the academic progress to members of society, which is the stakeholder

A3D: You will be able to nurture junior students in educational institutions, inculcating in them an interest in academics and enabling them to later join in the pioneering of new academic disciplines or research areas

The Graduate Attributes of the Productive Leader Program (PLP) are listed in Table A-2 as follows:

P0D: You will be able to precisely draw your own career plan and self-train yourself to acquire the skills required for attaining your goals in the industry, etc.

P1D: You will be able to precisely grasp the needs of society and detect its problems, and lead the future developments in science and technology

P2D: While leading teams consisting of members with varied specialties and value systems, you will be able to create products and enterprises that bring forth new values in the society

P3D: Through the project, you will be able to nurture junior students, enabling them to later join in the development of next generation society and industry

Table D3-1. Courses of the Graduate Major in Mathematics recognized as equivalent to Career Development Courses in the Academic Leader Program (ALP)

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	XIP.A601		★	Advanced International Practice in Science	0-2-0	A1D		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	A0D A2D	F	
	MTH.K602.L			Mathematical Science Career Development B	0-1-0	A0D A2D	F	
	MTH.K603.L			Mathematical Science Career Development C	0-1-0	A0D A2D	F	
	MTH.K604.L			Mathematical Science Career Development D	0-1-0	A0D A2D	F	
	MTH.K605.L			Mathematical Science Tutorial A	0-1-0	A1D A3D	F	
	MTH.K606.L			Mathematical Science Tutorial B	0-1-0	A1D A3D	F	
	MTH.K607.L			Mathematical Science Tutorial C	0-1-0	A1D A3D	F	
	MTH.K608.L			Mathematical Science Tutorial D	0-1-0	A1D A3D	F	
	MTH.K609.L			Advanced Career Program of Mathematical Science	0-1-0	A1D A3D	F	

★: Classes in English

Credits in Career Development 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

Table D3-2. Courses of the Graduate Major in Mathematics recognized as equivalent to Career Development Courses in the Productive Leader Program (PLP)

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	XIP.A601		★	Advanced International Practice in Science	0-2-0	P1D		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	P0D P2D	F	
	MTH.K602.L			Mathematical Science Career Development B	0-1-0	P0D P2D	F	
	MTH.K603.L			Mathematical Science Career Development C	0-1-0	P0D P2D	F	
	MTH.K604.L			Mathematical Science Career Development D	0-1-0	P0D P2D	F	
	MTH.K605.L			Mathematical Science Tutorial A	0-1-0	P1D P3D	F	
	MTH.K606.L			Mathematical Science Tutorial B	0-1-0	P1D P3D	F	
	MTH.K607.L			Mathematical Science Tutorial C	0-1-0	P1D P3D	F	
	MTH.K608.L			Mathematical Science Tutorial D	0-1-0	P1D P3D	F	
	MTH.K609.L			Advanced Career Program of Mathematical Science	0-1-0	P1D P3D	F	

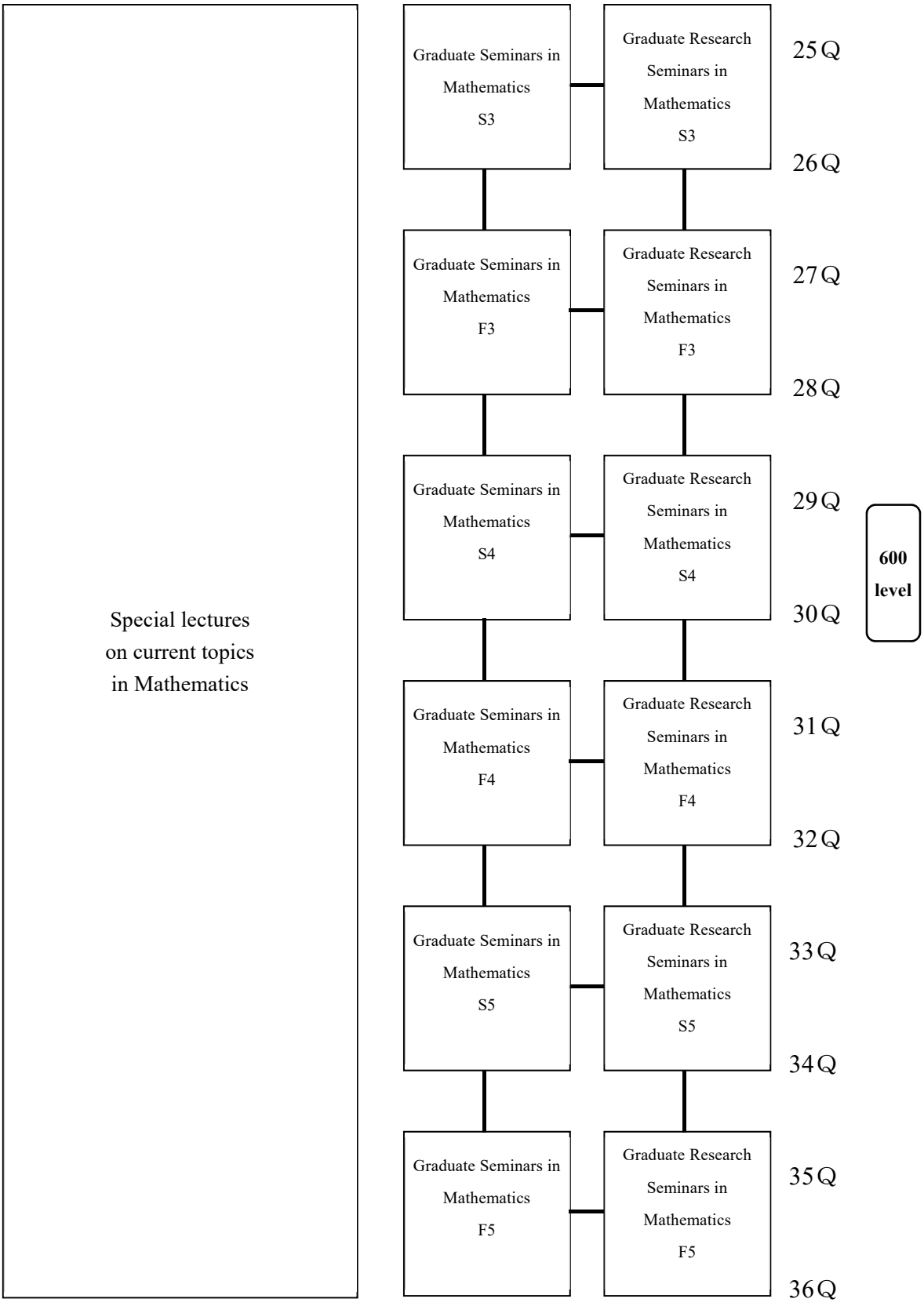
★: Classes in English

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

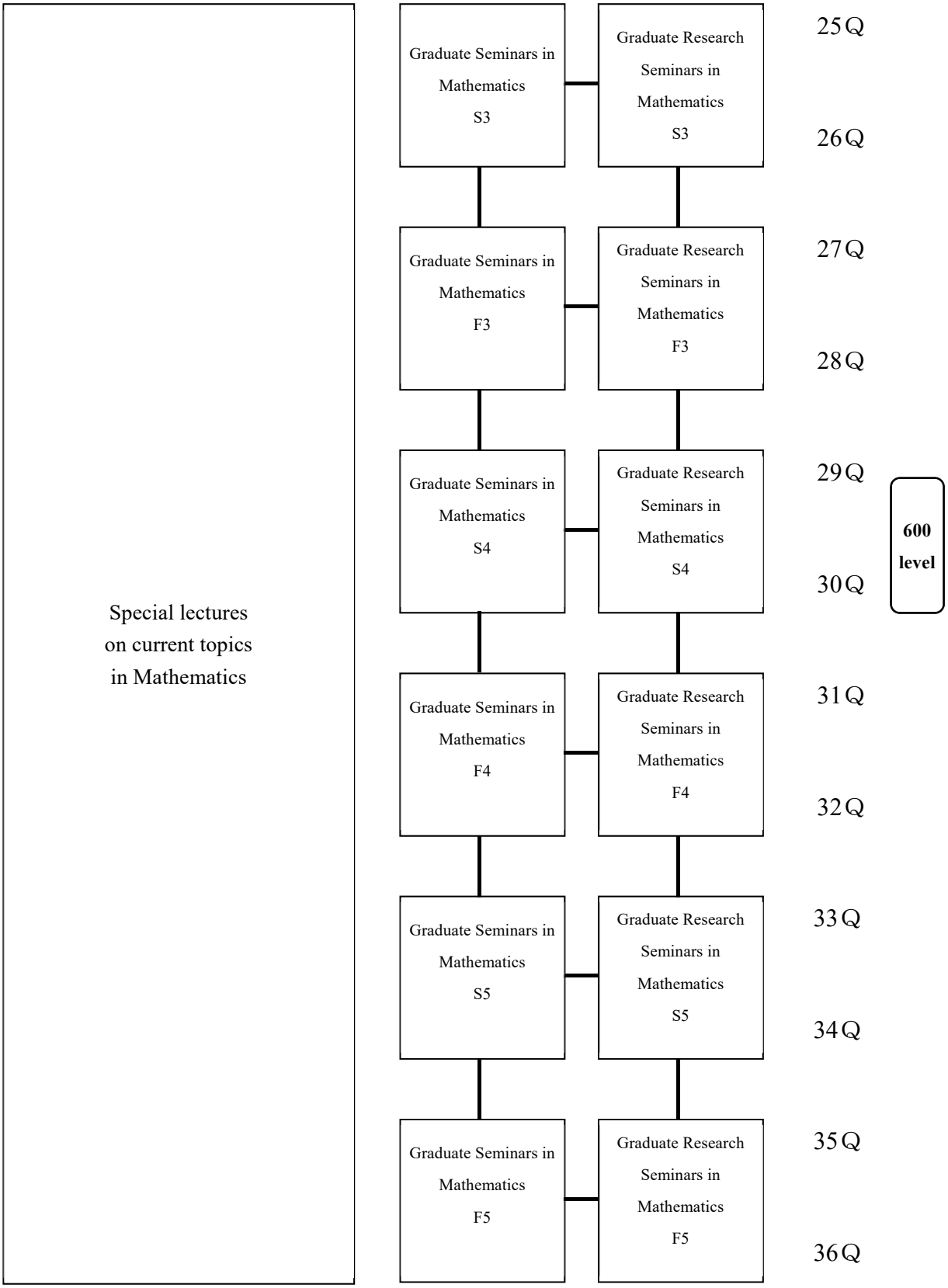
＊GA: Graduate Attributes

Students enrolled in the educational program for leading graduate schools or in the Tokyo Tech Academy for Leadership (ToTAL) may be offered courses recognized as equivalent to Career Development Courses besides those listed as such in the "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 that offers the relevant program.

8. Overview of Curriculum System



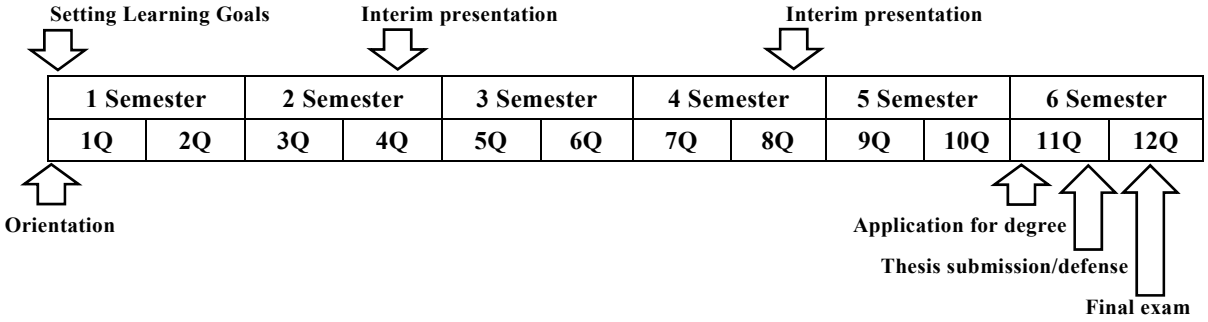
9. Example of a Standard Curriculum



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 judgement, the committee will check the candidate’s comprehension of the subject.