Graduate Major in Chemistry

【Doctoral Degree Program】

1. Outline

The purpose of the program is to train young talents to have a broad knowledge of both fundamental and specialized issues related to materials, to encourage them to become leaders of a specialized field related to Chemistry and to contribute natural science and applied fields.

2. Competencies Developed

We focus on the academic development of the following competencies:

・Have a broad and deep knowledge of Chemistry related topics, and can utilize this knowledge to approach new chemical problems

・Lead research at the frontiers of chemical sciences with a strong sense of responsibility and ethics

・Integrate the results of various fields related to materials research from a chemistry point of view, and actively use this knowledge

・Demonstrate international leadership in the field of study

3. Learning Goals

The curriculum will help to develop these competencies using the following approaches:

A) Study advanced challenges

Using the specialized skills from the master program, identifies new, important scientific problems and able to solve them

B) Able to integrate different fields of knowledge and organize them into new systems

C) Achieve international leadership in the study fields

4. IGP Completion Requirements

The following requirements must be met to complete the Doctoral Degree Program of this major.

1. Attain a total of 24 credits or more from 600-level courses.
2. From the courses specified in the Graduate Major in Chemistry curriculum,
    - 12 credits acquired from Research Seminars in Chemistry
    - 1 credit acquired from Advanced Exercise in Chemistry
    - a minimum of 18 credits acquired from Core Courses of the Graduate Major in Chemistry

• a minimum of 6 credits acquired from Liberal Arts and Basic Science Courses

(2 credits from Humanities and Social Science Courses, and 4 credits from Career Development Courses).

3. At least one paper published in a good peer-reviewed journal in the subject of the doctoral thesis. As a general rule, the student should be the first author. A paper accepted for publication is considered to be equivalent to published papers.

4. 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 Chemistry 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	B	
	Career development courses		4 credits		B, C	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar in Chemistry S3 Seminar in Chemistry F3 Seminar in Chemistry S4 Seminar in Chemistry F4 Seminar in Chemistry S5 Seminar in Chemistry F5 A total of 12 credits, 2 credits each from the above courses.		18 credits	A, B	
	Research-related courses				A, B	
	Major courses	Advanced Exercise in Chemistry, 1 credit			A, B, C	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Chemistry 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 Chemistry

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	600 level	CHM.Z691.R	◎	★	Seminar in Chemistry S3	0-2-0	1,2,3,4	A,B	
		CHM.Z692.R	◎	★	Seminar in Chemistry F3	0-2-0	1,2,3,4	A,B	
		CHM.Z693.R	◎	★	Seminar in Chemistry S4	0-2-0	1,2,3,4	A,B	
		CHM.Z694.R	◎	★	Seminar in Chemistry F4	0-2-0	1,2,3,4	A,B	
		CHM.Z695.R	◎	★	Seminar in Chemistry S5	0-2-0	1,2,3,4	A,B	
		CHM.Z696.R	◎	★	Seminar in Chemistry F5	0-2-0	1,2,3,4	A,B	
Major courses	600 level	CHM.A641.L		★E	Colloquium on Advanced Chemistry I	1-0-0	1,3	A,B,C	
		CHM.A642.L		★E	Colloquium on Advanced Chemistry II	1-0-0	1,3	A,B,C	
		CHM.A643.L		★O	Colloquium on Advanced Chemistry III	1-0-0	1,3	A,B,C	
		CHM.A644.L		★O	Colloquium on Advanced Chemistry IV	1-0-0	1,3	A,B,C	
		CHM.A651.L			Laboratory Training of Advanced Chemistry I	0-0-1	1,2,3,4,5	C	
		CHM.A652.L			Laboratory Training of Advanced Chemistry II	0-0-1	1,2,3,4,5	C	
		CHM.A653.L			Laboratory Training of Advanced Chemistry III	0-0-1	1,2,3,4,5	C	
		CHM.A654.L			Laboratory Training of Advanced Chemistry IV	0-0-1	1,2,3,4,5	C	

		CHM.A661.L		★	Basic Exercises in Global Presentation	0-1-0	1,2,3	C	
		CHM.A662.L		★	Advanced Exercises in Global Presentation	0-1-0	1,2,3	C	
		CHM.L670.R	◎	★	Advanced Exercise in Chemistry	0-1-0	2,3,4,5	A,B,C	
		CHM.L671.L		★	Advanced Laboratory Work in Chemistry I	0-0-1	1,2,3,4, 5	A,B	
		CHM.L672.L		★	Advanced Laboratory Work in Chemistry II	0-0-1	1,2,3,4, 5	A,B	
		CHM.L673.L		★	Advanced Laboratory Work in Chemistry III	0-0-1	1,2,3,4, 5	A,B	
		CHM.L674.L		★	Advanced Laboratory Work in Chemistry IV	0-0-1	1,2,3,4, 5	A,B	
		CHM.L675.L		★	Advanced Laboratory Work in Chemistry V	0-0-1	1,2,3,4, 5	A,B	
		CHM.L676.L		★	Advanced Laboratory Work in Chemistry VI	0-0-1	1,2,3,4, 5	A,B	

Note：

• ◎：Required course, ○：Restricted elective, ★: Classes in English O：odd academic years, E ：even academic years

• 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: Basic Chemistry, B: Inorganic/Analytical Chemistry, C: Physical Chemistry D: Organic Chemistry, 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 Chemistry 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 Chemistry standard curriculum
	CHM.A651.L			Laboratory Training of Advanced Chemistry I	0-0-1	A2D, A3D	C	
	CHM.A652.L			Laboratory Training of Advanced Chemistry II	0-0-1	A2D, A3D	C	
	CHM.A653.L			Laboratory Training of Advanced Chemistry III	0-0-1	A2D, A3D	C	

	CHM.A654.L			Laboratory Training of Advanced Chemistry IV	0-0-1	A2D, A3D	C	
	CHM.A661.L		★	Basic Exercises in Global Presentation	0-1-0	A1D, A2D	C	
	CHM.A662.L		★	Advanced Exercises in Global Presentation	0-1-0	A2D, A3D	C	

★: 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 Chemistry 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 Chemistry standard curriculum
	CHM.A651.L			Laboratory Training of Advanced Chemistry I	0-0-1	P2D, P3D	C	
	CHM.A652.L			Laboratory Training of Advanced Chemistry II	0-0-1	P2D, P3D	C	
	CHM.A653.L			Laboratory Training of Advanced Chemistry III	0-0-1	P2D, P3D	C	
	CHM.A654.L			Laboratory Training of Advanced Chemistry IV	0-0-1	P2D, P3D	C	
	CHM.A661.L		★	Basic Exercises in Global Presentation	0-1-0	P1D, P2D	C	
	CHM.A662.L		★	Advanced Exercises in Global Presentation	0-1-0	P2D, P3D	C	

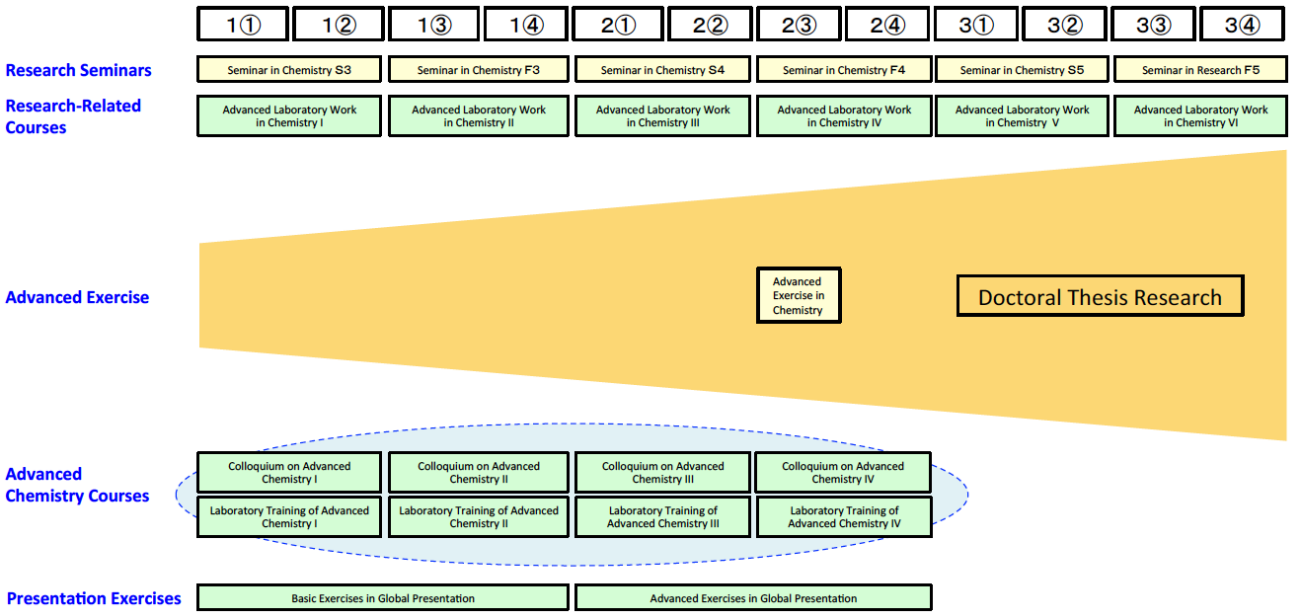
★: Classes in English

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.

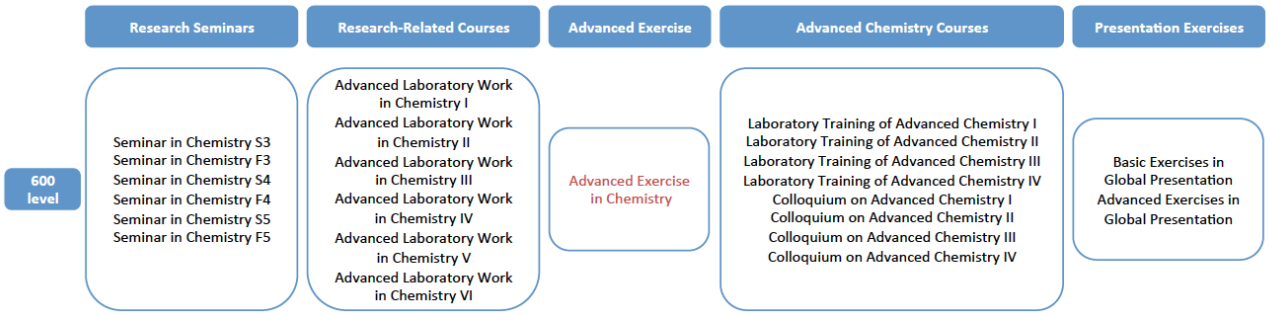
＊GA: Graduate Attributes

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

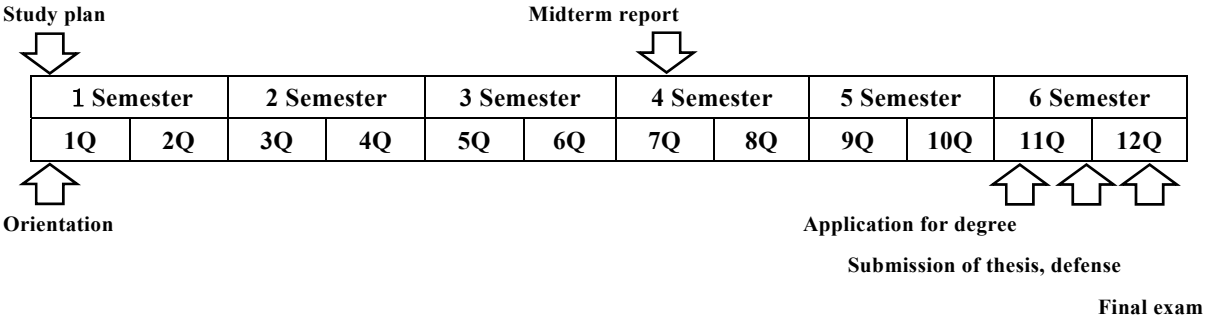


9. Example of a Standard Curriculum



10. Research Related to the Completion of Doctoral Theses

Through the doctoral thesis research, the candidate should discover new problem of significant importance in international scientific enterprise, and develop the abilities for pointing out the issues to be solved, analyzing the situations, and proposing the solution. At the same time, communication skills are also gained to publish the results nationally and internationally. The doctoral thesis, the thesis presentation and the final exam are based on the compilation of these achievements.



The criteria for examination

Following requirements must be met for the qualification:

1. The thesis should be original and is confirmed to be the world level of research which would contribute to the development of the academic field of chemistry.
2. The subject of the doctoral thesis should be published as at least one paper in a good peer-reviewed journal. As a general rule, the student should be the first author. A paper accepted for publication is considered to be equivalent to published papers.