Graduate Major in Physics

【Master's Degree Program】

1. Outline

The physics course aims to explore the fundamental laws and principles underlying physical phenomena and understand elementary particles, nuclei to universe in unified framework, and also to explore new substances and investigate the structural and physical properties of substances. This program aims to foster the flexible and creative human resources with the sound knowledge of physics, as researchers, teachers and engineers.
A systematic curriculum is provided in order that students can learn the general knowledge of physics and can make research of specialized fields through seminars and experiments under the instruction of their supervisors. An opportunity for research and education in partnership with other universities and research institutes is also provided. This program is composed of "class subjects" to learn systematically the advanced knowledge and technique for physics and skills of international communication and leadership, and "supervision" to be grounded researchers.

2. Competencies Developed

- Academic competency required for multifaceted understanding to physical phenomena.
- Practical competency to solve problems based on grounded knowledge of physics.
- Competency to explore the fundamental laws and principles underlying physical phenomena.
- Language competency and competency to discuss required for international research activities.
- Competency to conduct creative research with ethical perspective.

3. Learning Goals

The goals of the active learning provided in the course to obtain the competencies described in the curriculum are as follows:

A) Mastery of deep understanding in physics and high-standard specialized knowledge through seminars and ones own study for the doctor thesis

B) Mastery of skills to creatively establish and solve problems through the thesis study and small-group education in each state-of-the-art science laboratory

C) Mastery of cutting-edge knowledge in intensive courses

D) Mastery of practical skills for foreign language, academic presentations, and scientific communications through pragmatical classes, colloquiums, and overseas visits

E) Mastery of the leadership through the planning and arrangement of international research meetings

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 30 credits or more from 400- and 500-level courses.
2. Meet the completion requirements from the courses specified in the Graduate Major in Physics curriculum (see Table M1 below).
   - 4 credits acquired from Research Seminars.
   - 2 credits for Colloquium in Physics I and II, and 8 credits or more from Exercises in Physics Course or Laboratory Work in Physics Course acquired from Research Related Courses.
   - A minimum of 23 credits acquired from major courses, including Research Seminars and Research Related Courses.
   - A minimum of 5 credits acquired from Liberal Arts and Basic Science Courses, including 2 credits or more from 400-level and one credit or more from 500-level Humanities and Social Science Courses, and 2 credits or more from Career Development Courses.
3. 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 Physics 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		
	Career development courses		2 credits		D, E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	**Research seminars**	Research Seminar in Physics S1 Research Seminar in Physics F1 Research Seminar in Physics S2 Research Seminar in Physics F2 A total of 4 credits, 1 credit each from the above courses.		23 credits	A, B	
	Research-related courses	Colloquium in Physics I Colloquium in Physics II A total of 2 credits, 1 credit each from the above courses.	Exercises in Physics Course or Laboratory Work in Physics Course A total of 8 credits from the above courses.		C, D, E	
	Major courses				A, C, D, E	
	Major courses and Research-related courses <u>outside</u> the					

	Graduate Major in Physics standard curriculum					
Total required credits	**A minimum of 30 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 Physics

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	**400 level**	PHY.Z491.R	◎		Seminar in Physics S1	0-1-0	1,2,3	A, B	
		PHY.Z492.R	◎		Seminar in Physics F1	0-1-0	1,2,3	A, B	
	500 level	PHY.Z591.R	◎		Seminar in Physics S2	0-1-0	1,2,3	A, B	
		PHY.Z592.R	◎		Seminar in Physics F2	0-1-0	1,2,3	A, B	
Research-related courses	**400 level**	PHY.P403.B	○		Exercises in Physics Course S1	0-2-0	1,2,3,4,5	A, B	
		PHY.P404.B	○		Laboratory Work in Physics Course S1	0-0-2	1,2,3,4,5	A, B	
		PHY.P405.B	○		Exercises in Physics Course F1	0-2-0	1,2,3,4,5	A, B	
		PHY.P406.B	○		Laboratory Work in Physics Course F1	0-0-2	1,2,3,4,5	A, B	
		PHY.P413.L		★	Practical Exercises in International Research I	0-1-0	1,2,3,4,5	D	
		PHY.P414.L		★	Practical Exercises in International Research II	0-1-0	1,2,3,4,5	D	
		PHY.P415.L		★	Practical Exercises in Organizing International Conferences I	0-1-0	1,2,3	D, E	

		PHY.P416.L		★	Practical Exercises in Organizing International Conferences II	0-1-0	1,2,3	D, E	
		PHY.P417.R	◎		Colloquium in Physics I	0-1-0	2	D	
		PHY.P418.R	◎		Colloquium in Physics II	0-1-0	2	D	
	500 level	PHY.P503.B	○		Exercises in Physics Course S2	0-2-0	1,2,3,4,5	A, B	
		PHY.P504.B	○		Laboratory Work in Physics Course S2	0-0-2	1,2,3,4,5	A, B	
		PHY.P505.B	○		Exercises in Physics Course F2	0-2-0	1,2,3,4,5	A, B	
		PHY.P506.B	○		Laboratory Work in Physics Course F2	0-0-2	1,2,3,4,5	A, B	
Major courses	**400 level**	PHY.C439.L			Physics of Magnetic Materials	1-0-0	3,5	A	
		PHY.C441.L			Crystal Physics	2-0-0	3,5	A	
		PHY.C442.L			Superfluidity	1-0-0	3,5	A	
		PHY.C443.L			Superconductivity	1-0-0	3,4,5	A	
		PHY.C444.L			Quantum Transport	1-0-0	3,5	A	
		PHY.C445.L			Surface Physics	1-0-0	3,5	A	
		PHY.C446.L			Light and Matter I	1-0-0	3,4,5	A	
		PHY.C447.L			Light and Matter II	1-0-0	3	A	
		PHY.C448.L			Light and Matter III	1-0-0	3	A	
		PHY.C449.L			Laser Physics	1-0-0	3	A	
		PHY.C450.L			Quantum Theory of Electrons in Solids	2-0-0	3,4,5	A	
		PHY.F430.L			Hadron Physics	2-0-0	3,5	A	
		PHY.F431.L			Cosmology	1-0-0	3	A	
		PHY.F432.L			Astrophysics	1-0-0	3	A	
		PHY.F436.L			Advanced Particle Physics	2-0-0	1,3	A	

		PHY.F437.L			Advanced Nuclear Physics	2-0-0	3,4,5	A	
		PHY.L412.L			Fundamental Physics Experiments	0-0-1	1,2,3,4,5	A	
		PHY.P410.L		★	Basic Writing in Physics	2-0-0	2,3,4	D	
		PHY.P411.L		★	Basic Presentation in Physics	2-0-0	1,2,5	D	
		PHY.Q433.L			Field Theory I	2-0-0	3,5	A	
		PHY.Q434.L			Field Theory II	2-0-0	3	A	
		PHY.Q435.L			Quantum Information	2-0-0	3,4	A	
		PHY.Q438.L			Quantum Mechanics of Many-Body Systems	2-0-0	3,5	A	
		PHY.S440.L			Statistical Mechanics III	2-0-0	3	C	
	500 level	PHY.P530.L			Special Lectures in Physics I	1-0-0	3,5	C	
		PHY.P531.L			Special Lectures in Physics II	1-0-0	3,5	C	
		PHY.P532.L		★	Special Lectures in Physics III	1-0-0	3,5	C	
		PHY.P533.L			Special Lectures in Physics IV	1-0-0	3,5	C	
		PHY.P534.L			Special Lectures in Physics V	1-0-0	3,5	C	
		PHY.P535.L			Special Lectures in Physics VI	1-0-0	3,5	C	
		PHY.P536.L			Special Lectures in Physics VII	1-0-0	3	C	
		PHY.P537.L		★	Special Lectures in Physics VIII	1-0-0	3,4,5	C	
		PHY.P538.L		★	Special Lectures in Physics IX	1-0-0	2,3,5	C	
		PHY.P539.L			Special Lectures in Physics X	1-0-0	3,4	C	
		PHY.P540.L			Special Lectures in Physics XI	1-0-0	3,5	C	
		PHY.P541.L			Special Lectures in Physics XII	1-0-0	3,5	C	
		PHY.P542.L		★	Special Lectures in Physics XIII	1-0-0	3,5	C	

		PHY.P543.L			Special Lectures in Physics XIV	1-0-0	3,5	C	
		PHY.P544.L			Special Lectures in Physics XV	1-0-0	3,5	C	
		PHY.P545.L			Special Lectures in Physics XVI	1-0-0	3,5	C	
		PHY.P546.L			Special Lectures in Physics XVII	1-0-0	3,5	C	
		PHY.P547.L			Special Lectures in Physics XVIII	1-0-0	3,5	C	
		PHY.P548.L			Special Lectures in Physics XIX	1-0-0	3,5	C	
		PHY.P549.L		★	Special Lectures in Physics XX	1-0-0	3,5	C	
		PHY.P560.L			Special Lectures in Physics XXI	1-0-0	3,5	C	
		PHY.P550.L			Special Topics in Physics I	1-0-0	3,5	C	
		PHY.P551.L			Special Topics in Physics II	1-0-0	3,5	C	
		PHY.P552.L			Special Topics in Physics III	1-0-0	3,5	C	
		PHY.P553.L			Special Topics in Physics IV	1-0-0	3,5	C	
		PHY.P554.L			Special Topics in Physics V	1-0-0	3,5	C	
		PHY.P555.L			Special Topics in Physics VI	1-0-0	3,5	C	
		PHY.P556.L			Special Topics in Physics VII	1-0-0	3	C	
		PHY.P557.L		★ □	Fundamentals of Light and Matter IIb	1-0-0	3	C	【Electrical and Electronic Engineering】(EEE.D532)
		PHY.P558.L		□	Fundamental of spectroscopic measurements and its development	1-0-0	3	C	【Electrical and Electronic Engineering】(EEE.D541)

Note：

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

• □：Course recognized as equivalent to that of the Academy for Co-creative Education of Environment and Energy Science (ACEEES).

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = Practical and/or problem-solving skills

• 【 】Course offered by another graduate major

• 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): C: Condensed matter physics, E: Electromagnetism, F: Fundamental physics, G: General, L: Laboratory, M: Mathematical physics, P: Common, Q: Quantum mechanics, S: Statistical mechanics, 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 Physics 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 Physics standard curriculum

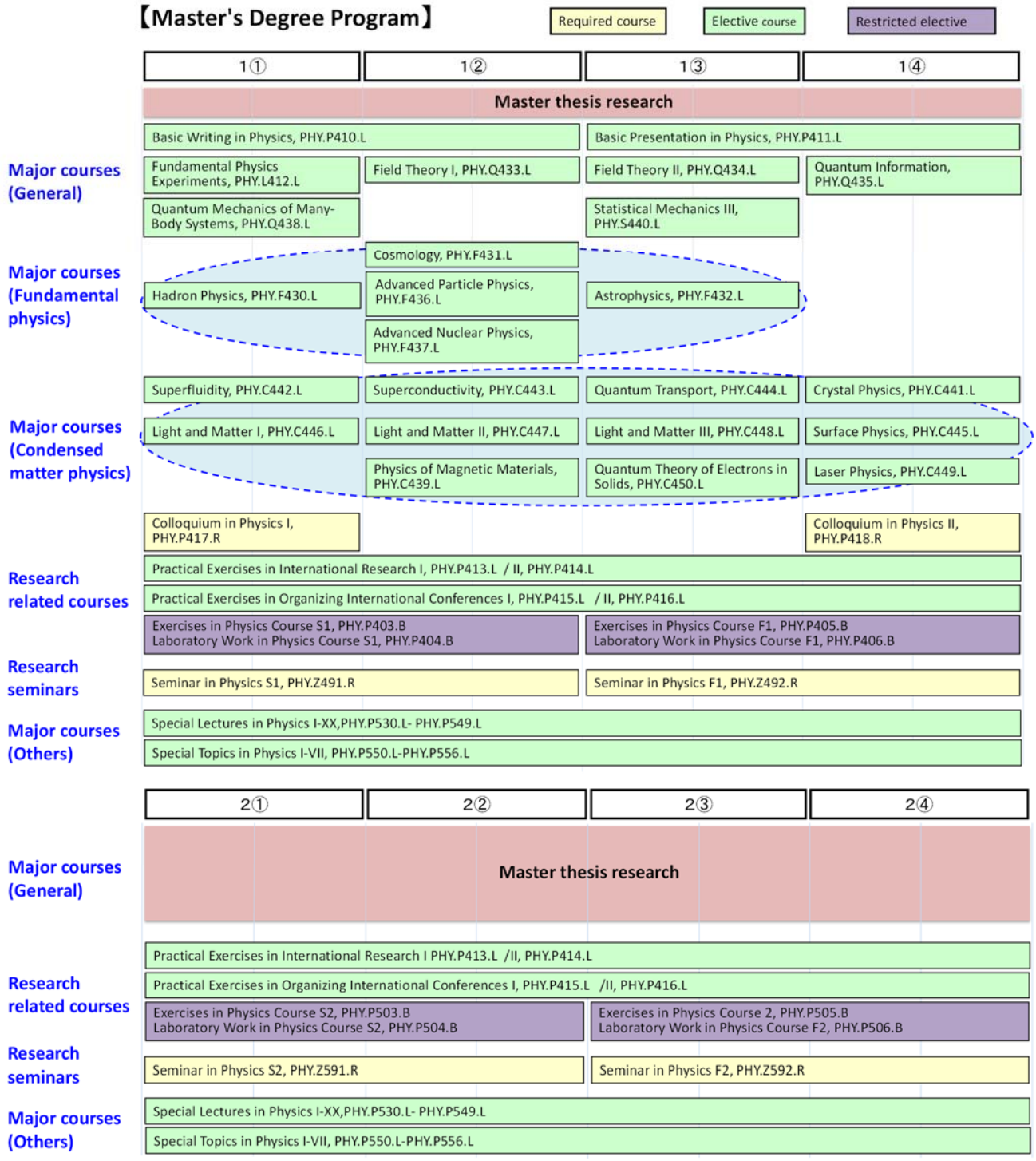
	PHY.P413.L		★	Practical Exercises in International Research I	0-1-0	C1M	D	
	PHY.P414.L		★	Practical Exercises in International Research II	0-1-0	C1M	D	
	PHY.P415.L		★	Practical Exercises in Organizing International Conferences I	0-1-0	C1M	D, E	
	PHY.P416.L		★	Practical Exercises in Organizing International Conferences II	0-1-0	C1M	D, E	
	PHY.P410.L		★	Basic Writing in Physics	2-0-0	C0M	D	
	PHY.P411.L		★	Basic Presentation in Physics	2-0-0	C0M	D	

★ : Classes in English

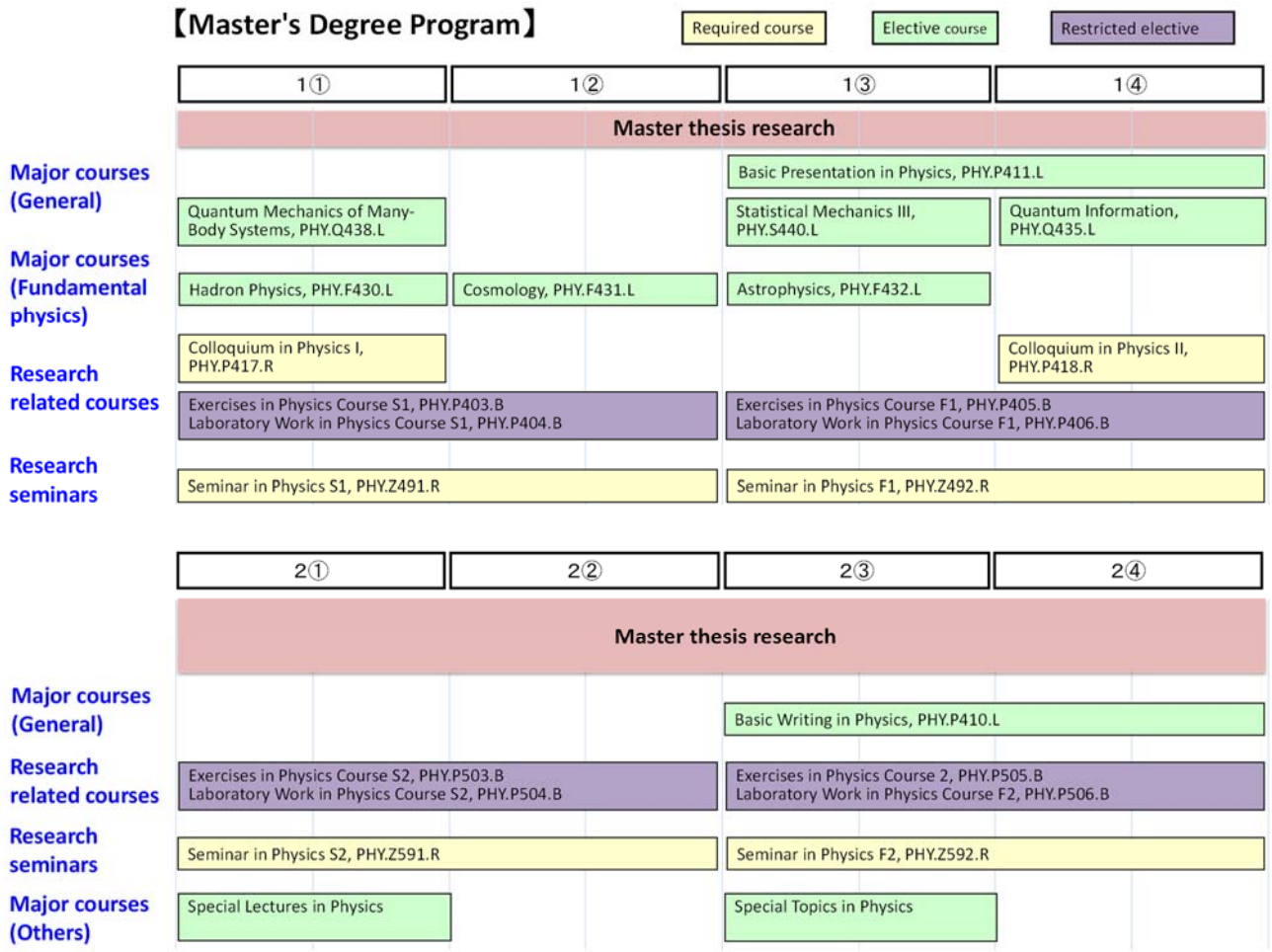
Credits in Career Development Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

＊GA: Graduate Attributes

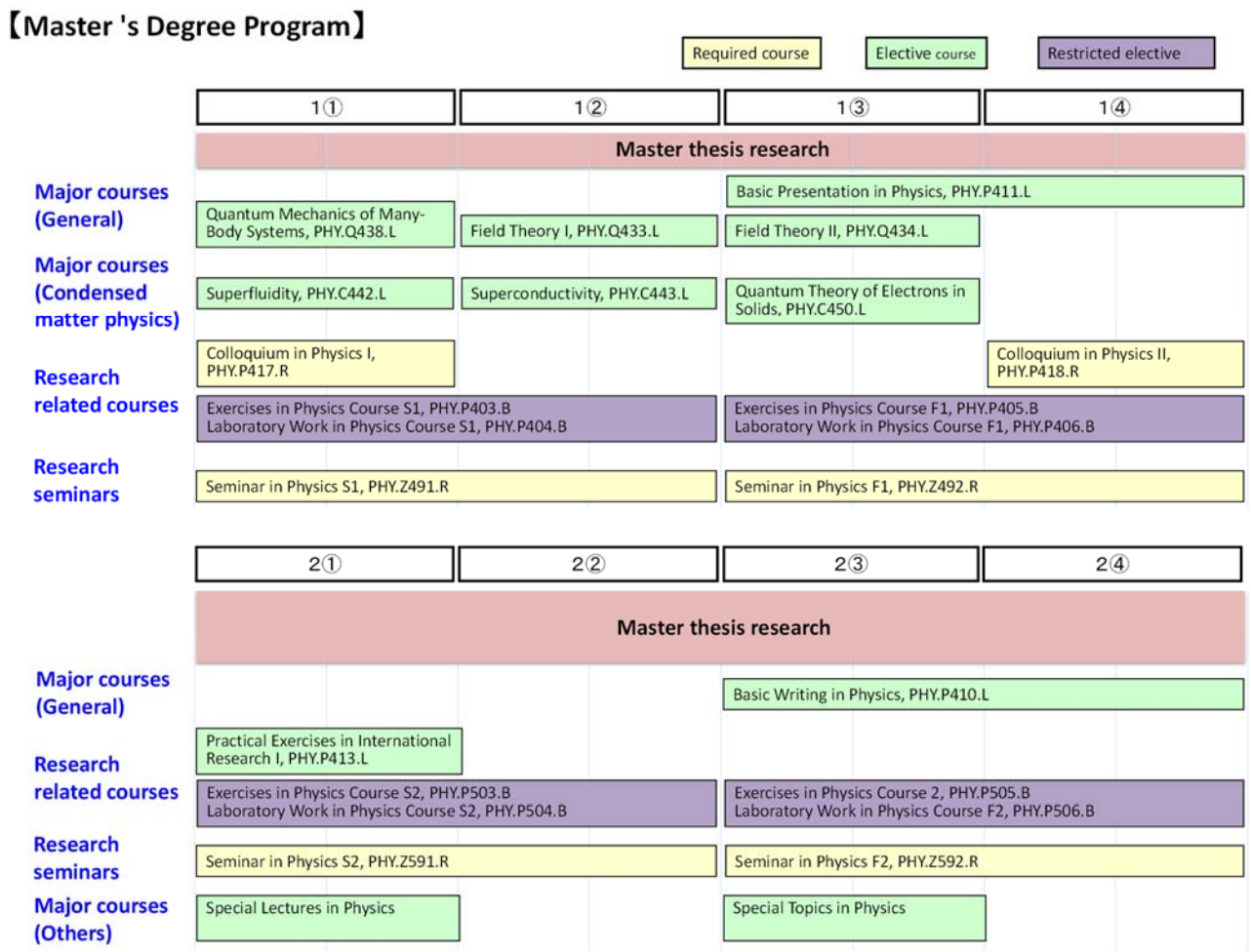
8. Overview of Curriculum System



9. Example of a Standard Curriculum 1



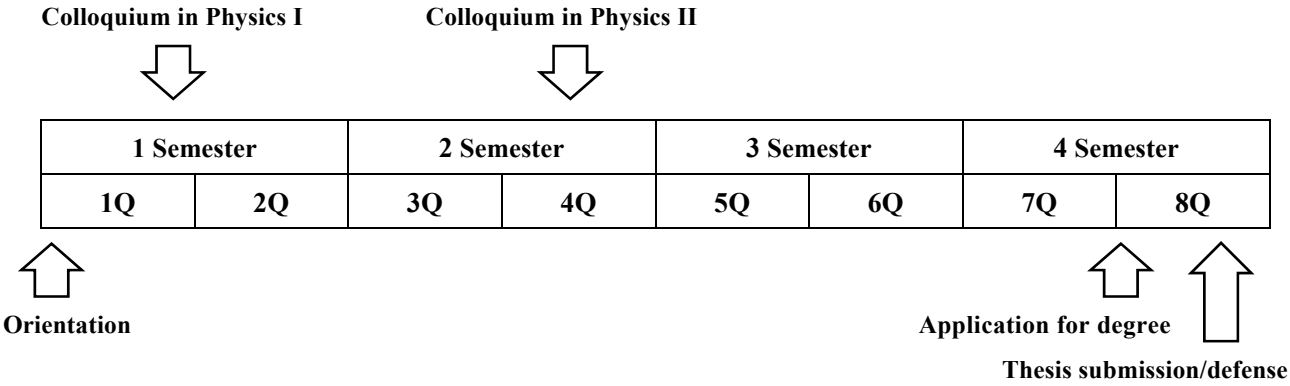
9. Example of a Standard Curriculum 2



10. Research Related to the Completion of Master Theses

In the master thesis research, students experience the research process through the small-group specialized instruction in each laboratory promoting cutting-edge research and develop their own skills in problem establishment, problem solving and communication through preparation of theses.

Study Plan



• The criteria for examination

Following requirements must be met.

1. On the research content
   The content should be the level that contributes the progress in relevant research field.
2. On the thesis
   It includes an adequate review of the relevant research field. The relative position of the research in the field needs to be clear.

• The thesis review procedure

The review committee consists of at least three faculty members of the physics course. 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. In this case, a part of presentation is performed in English.

11. Seamless Transition Between Degree Programs

The course program is constructed in order that students can satisfactorily advance their research from the global point of view on the basis of the basic, advanced and cutting-edge knowledge that they learned in the master course. The curriculum includes advanced training courses for research presentation and writing of paper, and courses for the support of overseas research activities and those for training for organizing international conferences.

• Deep understanding in physics acquired by exploring the fundamental laws and principles underlying physical phenomena.
• Competency to penetrate the essence and universality in physical phenomena and that to discover and explore new problems
• Competency to create new knowledge and that to transmit it.
• Competency to lead research frontiers in physics with deep insight and ethical perspective.
• Competency to relate organically physics and other research fields and that to make practical use of the relation.
• Competency to show international leadership in specialized research fields.

As shown in Table D2, the PhD curriculum provides practical major courses of 600-level as those which support domestic and overseas research activities, bearing the internationalization in mind. Advancing major courses of 400- and 500-levels, the PhD curriculum aims to foster researchers who are active in the world.

【Doctoral Degree Program】

1. Outline

This program aims to foster the human resources who can contribute to the progress of the society and the development of natural science. We expect the students to become the leaders in the fundamental natural science field, and to preserve and develop the science with uninhibited ideas and intellectual curiosities.

2. Competencies Developed

The program focuses on the academic development of the following competencies, and sets the higher standard than that in the master course.

- Competency to create and send out new findings based on the broad and systematic knowledge of natural science
- Competency to discover and explore new subjects with deep considerations of the essence and universality
- Competency to lead the forefront of natural science with deep insight and noble ethics
- Competency to organically combine and utilize the knowledge of natural science and broad spectrum of understandings in other fields
- Competency to take the initiative in ones special research area of natural science

3. Learning Goals

The goals of the active learning provided in the course to obtain the competencies described in the curriculum are as follows:

A) Mastery of deep understanding in physics and high-standard specialized knowledge through seminars and ones own study for the doctor thesis
B) Mastery of skills to creatively establish and solve problems through the thesis study and small-group education in each state-of-the-art science laboratory
C) Mastery of cutting-edge knowledge in intensive courses
D) Mastery of practical skills for foreign language, academic presentations, and scientific communications through pragmatical classes, colloquiums, and overseas visits
E) Mastery of the leadership through the planning and arrangement of international research meetings

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.
2. Meet the completion requirements from the courses specified in the Graduate Major in Physics curriculum (see Table D1 below),
   - a minimum of 12 credits acquired from Major Courses, including 12 credits acquired from Research Seminars ; and
   - 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. 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 Physics 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="4">6 credits</td><td></td><td></td></tr>
<tr><td>Career development courses</td><td></td><td>4 credits</td><td>D, E</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="5">Core courses</td><td>Research seminars</td><td>Seminar in Physics S3
Seminar in Physics F3
Seminar in Physics S4
Seminar in Physics F4
Seminar in Physics S5
Seminar in Physics F5
A total of 12 credits, 2 credits each from the above courses.</td><td></td><td rowspan="4">12 credits</td><td>A, B</td><td></td></tr>
<tr><td>Research-related courses</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Major courses</td><td></td><td></td><td>C, D, E</td><td></td></tr>
<tr><td>Major courses and Research-related courses <u>outside</u> the Graduate Major in Physics 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 Physics

Course category		Course number			Course title	Credits	Competencies	Learning goals	Comments
Research seminars	600 level	PHY.Z691.R	◎		Seminar in Physics S3	0-2-0	1,2 3	A, B	
		PHY.Z692.R	◎		Seminar in Physics F3	0-2-0	1,2,3	A, B	
		PHY.Z693.R	◎		Seminar in Physics S4	0-2-0	1,2,3	A, B	
		PHY.Z694.R	◎		Seminar in Physics F4	0-2-0	1,2,3	A, B	
		PHY.Z695.R	◎		Seminar in Physics S5	0-2-0	1,2,3	A, B	
		PHY.Z696.R	◎		Seminar in Physics F5	0-2-0	1,2,3	A, B	
Major courses	600 level	PHY.P610.L		★	Advanced Writing in Physics	2-0-0	2,3,4	D	
		PHY.P611.L		★	Advanced Presentation in Physics	2-0-0	1,2,5	D	
		PHY.P612.L			Colloquium for Physics Presentation I	0-1-0	2,3,4	D	
		PHY.P613.L			Colloquium for Physics Presentation II	0-1-0	2,3,4	D	
		PHY.P614.L			Colloquium for Physics Presentation III	0-1-0	2,3,4	D	
		PHY.P615.L		★	Overseas Visiting Research in Physics I	0-1-0	1,2,3	D	
		PHY.P616.L		★	Overseas Visiting Research in Physics II	0-1-0	1,2,3	D	
		PHY.P617.L		★	Overseas Visiting Research in Physics III	0-1-0	1,2,3	D	
		PHY.P618.L			Advanced Research in Physics I	0-1-0	2	D	
		PHY.P619.L			Advanced Research in Physics II	0-1-0	2	D	
		PHY.P620.L			Advanced Research in Physics III	0-1-0	2	D	

		PHY.P621.L		★	Overseas Research Project in Physics I	0-1-0	1,2,3,4,5	D	
		PHY.P622.L		★	Overseas Research Project in Physics II	0-1-0	1,2,3,4,5	D	
		PHY.P623.L		★	Overseas Research Project in Physics III	0-1-0	1,2,3,4,5	D	
		PHY.P624.L		★	Advanced Exercises in Organizing Physics Conferences I	0-1-0	1,2,3	E	
		PHY.P625.L		★	Advanced Exercises in Organizing Physics Conferences II	0-1-0	1,2,3	E	
		PHY.P626.L		★	Advanced Exercises in Organizing Physics Conferences III	0-1-0	1,2,3	E	
		PHY.P627.L		★	Advanced Exercises in Physics Presentation I	0-1-0	1,2,3	D	
		PHY.P628.L		★	Advanced Exercises in Physics Presentation II	0-1-0	1,2,3	D	
		PHY.P629.L		★	Advanced Exercises in Physics Presentation III	0-1-0	1,2,3	D	
		PHY.P630.L			Advanced Special Lectures in Physics I	1-0-0	3,4,5	C	
		PHY.P631.L			Advanced Special Lectures in Physics II	1-0-0	3,4,5	C	
		PHY.P632.L		★	Advanced Special Lectures in Physics III	1-0-0	3,4,5	C	
		PHY.P633.L			Advanced Special Lectures in Physics IV	1-0-0	3,4,5	C	
		PHY.P634.L			Advanced Special Lectures in Physics V	1-0-0	3,4,5	C	
		PHY.P635.L			Advanced Special Lectures in Physics VI	1-0-0	3,4,5	C	
		PHY.P636.L			Advanced Special Lectures in Physics VII	1-0-0	3	C	
		PHY.P637.L		★	Advanced Special Lectures in Physics VIII	1-0-0	3,4,5	C	
		PHY.P638.L		★	Advanced Special Lectures in Physics IX	1-0-0	2,3,5	C	
		PHY.P639.L			Advanced Special Lectures in Physics X	1-0-0	3,4	C	
		PHY.P640.L			Advanced Special Lectures in Physics XI	1-0-0	3,5	C	
		PHY.P641.L			Advanced Special Lectures in Physics XII	1-0-0	3,5	C	
		PHY.P642.L		★	Advanced Special Lectures in Physics XIII	1-0-0	3,5	C	

		PHY.P643.L			Advanced Special Lectures in Physics XIV	1-0-0	3,5	C	
		PHY.P644.L			Advanced Special Lectures in Physics XV	1-0-0	3,5	C	
		PHY.P645.L			Advanced Special Lectures in Physics XVI	1-0-0	3,5	C	
		PHY.P646.L			Advanced Special Lectures in Physics XVII	1-0-0	3,5	C	
		PHY.P647.L			Advanced Special Lectures in Physics XVIII	1-0-0	3,5	C	
		PHY.P648.L			Advanced Special Lectures in Physics XIX	1-0-0	3,5	C	
		PHY.P649.L		★	Advanced Special Lectures in Physics XX	1-0-0	3,5	C	
		PHY.P660.L			Advanced Special Lectures in Physics XXI	1-0-0	3,5	C	
		PHY.P650.L			Advanced Special Topics in Physics I	1-0-0	3,4,5	C	
		PHY.P651.L			Advanced Special Topics in Physics II	1-0-0	3,4,5	C	
		PHY.P652.L			Advanced Special Topics in Physics III	1-0-0	3,4,5	C	
		PHY.P653.L			Advanced Special Topics in Physics IV	1-0-0	3,4,5	C	
		PHY.P654.L			Advanced Special Topics in Physics V	1-0-0	3,5	C	
		PHY.P655.L			Advanced Special Topics in Physics VI	1-0-0	3,5	C	
		PHY.P656.L			Advanced Special Topics in Physics VII	1-0-0	3	A	

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): C: Condensed matter physics, E: Electromagnetism, F: Fundamental physics, G: General, L: Laboratory, M: Mathematical physics, P: Common, Q: Quantum mechanics, S: Statistical mechanics, 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 Physics 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 Physics standard curriculum
	PHY.P610.L		★	Advanced Writing in Physics	2-0-0	A1D, A2D	D	
	PHY.P611.L		★	Advanced Presentation in Physics	2-0-0	A1D, A2D	D	
	PHY.P612.L			Colloquium for Physics Presentation I	0-1-0	A2D, A3D	D	
	PHY.P613.L			Colloquium for Physics Presentation II	0-1-0	A2D, A3D	D	
	PHY.P614.L			Colloquium for Physics Presentation III	0-1-0	A2D, A3D	D	
	PHY.P615.L		★	Overseas Visiting Research in Physics I	0-1-0	A2D, A3D	D	
	PHY.P616.L		★	Overseas Visiting Research in Physics II	0-1-0	A2D, A3D	D	
	PHY.P617.L		★	Overseas Visiting Research in Physics III	0-1-0	A2D, A3D	D	
	PHY.P618.L			Advanced Research in Physics I	0-1-0	A0D, A2D	D	
	PHY.P619.L			Advanced Research in Physics II	0-1-0	A0D, A2D	D	
	PHY.P620.L			Advanced Research in Physics III	0-1-0	A0D, A2D	D	
	PHY.P621.L		★	Overseas Research Project in Physics I	0-1-0	A2D, A3D	D	
	PHY.P622.L		★	Overseas Research Project in Physics II	0-1-0	A2D, A3D	D	
	PHY.P623.L		★	Overseas Research Project in Physics III	0-1-0	A2D, A3D	D	

	PHY.P624.L		★	Advanced Exercises in Organizing Physics Conferences I	0-1-0	A2D, A3D	E	
	PHY.P625.L		★	Advanced Exercises in Organizing Physics Conferences II	0-1-0	A2D, A3D	E	
	PHY.P626.L		★	Advanced Exercises in Organizing Physics Conferences III	0-1-0	A2D, A3D	E	
	PHY.P627.L		★	Advanced Exercises in Physics Presentation I	0-1-0	A1D, A2D	D	
	PHY.P628.L		★	Advanced Exercises in Physics Presentation II	0-1-0	A1D, A2D	D	
	PHY.P629.L		★	Advanced Exercises in Physics Presentation III	0-1-0	A1D, A2D	D	

★ : 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 Physics 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 Physics standard curriculum
	PHY.P610.L	★	Advanced Writing in Physics		2-0-0	P1D, P2D	D	
	PHY.P611.L	★	Advanced Presentation in Physics		2-0-0	P1D, P2D	D	
	PHY.P612.L		Colloquium for Physics Presentation I		0-1-0	P2D, P3D	D	
	PHY.P613.L		Colloquium for Physics Presentation II		0-1-0	P2D, P3D	D	
	PHY.P614.L		Colloquium for Physics Presentation III		0-1-0	P2D, P3D	D	
	PHY.P615.	★	Overseas Visiting Research in Physics I		0-1-0	P2D,	D	

	L					P3D		
	PHY.P616.L		★	Overseas Visiting Research in Physics II	0-1-0	P2D, P3D	D	
	PHY.P617.L		★	Overseas Visiting Research in Physics III	0-1-0	P2D, P3D	D	
	PHY.P618.L			Advanced Research in Physics I	0-1-0	P0D, P2D	D	
	PHY.P619.L			Advanced Research in Physics II	0-1-0	P0D, P2D	D	
	PHY.P620.L			Advanced Research in Physics III	0-1-0	P0D, P2D	D	
	PHY.P621.L		★	Overseas Research Project in Physics I	0-1-0	P2D, P3D	D	
	PHY.P622.L		★	Overseas Research Project in Physics II	0-1-0	P2D, P3D	D	
	PHY.P623.L		★	Overseas Research Project in Physics III	0-1-0	P2D, P3D	D	
	PHY.P624.L		★	Advanced Exercises in Organizing Physics Conferences I	0-1-0	P2D, P3D	E	
	PHY.P625.L		★	Advanced Exercises in Organizing Physics Conferences II	0-1-0	P2D, P3D	E	
	PHY.P626.L		★	Advanced Exercises in Organizing Physics Conferences III	0-1-0	P2D, P3D	E	
	PHY.P627.L		★	Advanced Exercises in Physics Presentation I	0-1-0	P1D, P2D	D	
	PHY.P628.L		★	Advanced Exercises in Physics Presentation II	0-1-0	P1D, P2D	D	
	PHY.P629.L		★	Advanced Exercises in Physics Presentation III	0-1-0	P1D, P2D	D	

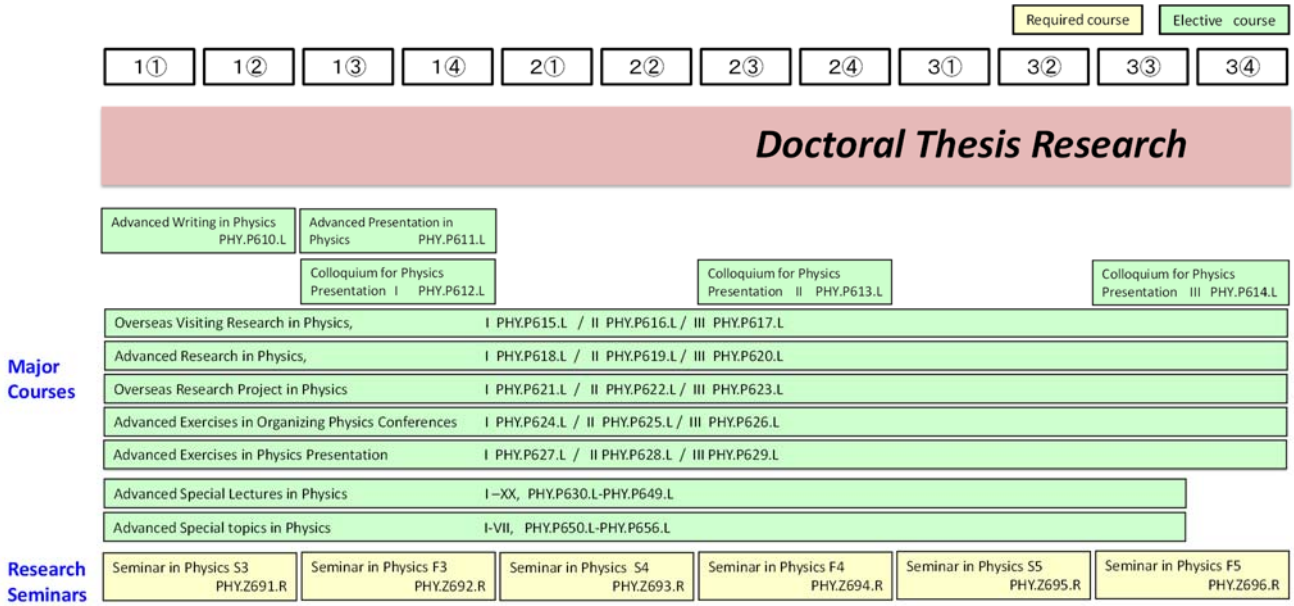
★ : Classes in English

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.

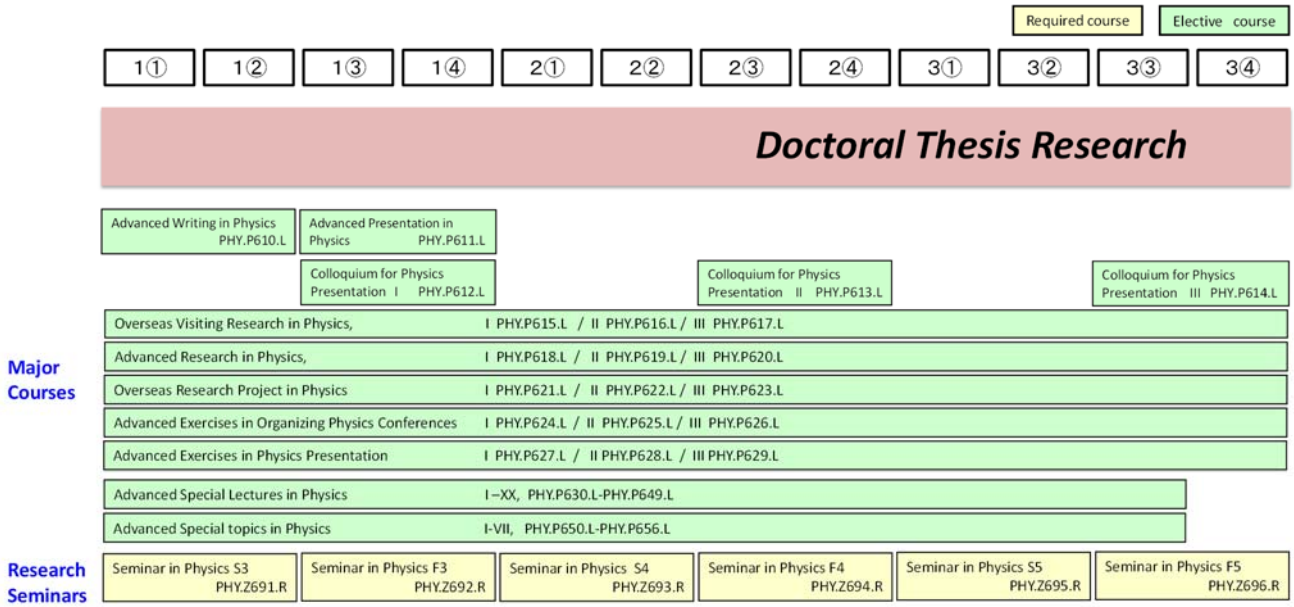
＊GA: Graduate Attributes

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

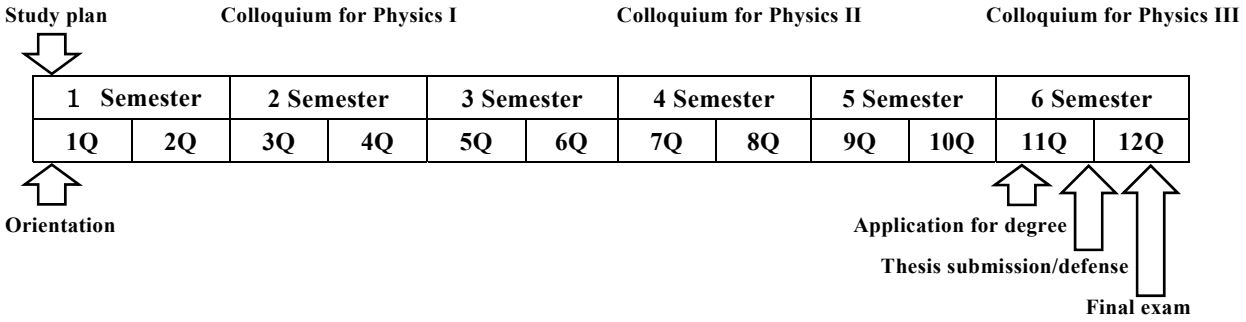


9. Example of a Standard Curriculum



10. Research Related to the Completion of Doctoral Theses

During the doctoral thesis research, students develop their own skills in setting up the subjects of significant importance and abilities to solve them. At the same time, communication skills in English are acquired.
In order to obtain the doctors degree, the thesis presentation and the final exam are required and are to be reviewed by referees.



The criteria for examination

Following requirements must be met for the qualification

1. The contents of the work
   The work is confirmed to be the world wide level of research which would contribute to the development of the field
2. The thesis
   i) It contains an adequate review of the research field, described in plain language.
   The relative position of the work in the specific field needs to be clear.
   ii) It is written in English.
   iii) A paper article to which the candidate has a major contribution is published in the international peer review journals, or the publication is confirmed *
   * In the special case where the publication is foreseen to delay due to the editorial reason, the thesis can be approved if the paper is expected to be published within a year.

The thesis review procedure

The review committee consists of at least five faculty members in the physics course. After the thesis presentation by the candidate, the thesis is reviewed by the referees, and the final exam follows.