

# **Graduate Major in Industrial Engineering and Economics**

## **【Master's Degree Program】**

### **1. Outline**

Towards achieving fundamental expertise in industrial engineering and economics, students learn advanced knowledge and skills in the fields of mathematical engineering, economics, business administration, and management techniques. The aims of this program are to cultivate deep insights about technology, organizational structures, and the economy, along with the ability to abilities to discover, investigate, and solve problems in the world.

### **2. Competencies Developed**

In order to pursue these educational goals, this program aims to develop the following competencies:

- Acquire fundamental knowledge for harnessing mathematical engineering, information, and engineering technologies.
- Acquire knowledge and viewpoints on industrial engineering and economics that allows for comprehension of management activities and programs in economics.
- Develop the ability to think deeply about technologies and organizational structures, as well as the ability to discover, analyze, and solve essential problems in the world.
- Develop the conceptual ability to structure and model real world problems.
- Develop the ability to explain, document, and communicate research and applied work in English and in Japanese.
- Develop the ability to pursue research on new problems and questions.

### **3. Learning Goals**

In order to develop the competences described above, students will learn the following:

A) Fundamental knowledge in industrial engineering and economics.

Learn fundamental knowledge at graduate level in order to utilize mathematical, information, and engineering technology freely.

B) Application of industrial engineering and economics

Learn the essential knowledge and viewpoints of industrial engineering and economics necessary to understand management activities and economic problems.

C) Broad viewpoints and an initiative for learning

Develop insights on technologies and organizational structures, the ability to discover, analyze, and solve essential problems in the world, and the conceptual ability to structure and model real world problems.

D) Understand how to engage with society

Vicariouly experience working within society as a professional as well as learn engineering ethics through lectures from practitioners.

E) Strengthen communication ability

Develop the ability to conduct research on new problems through a master's thesis research project, as well as the ability to explain and communicate information in English and Japanese through a colloquium and regular seminars.

#### 4. IGP Completion Requirements

The following requirements must be met in order to complete a master's degree program with this major:

1. Attain a total of 32 credits or more from 400- and 500-level courses.
2. From the courses specified in this graduate major curriculum:
  - 8 credits acquired from Research Seminars;
  - 2 credits acquired from Reading in Industrial Engineering and Economics;
  - a minimum of 12 credits acquired from Major Courses; and
  - a minimum of 5 credits acquired from Liberal Arts and Basic Science Courses

In particular, the 5 credits should include:

- (a) 2 credits from 400-level courses of Humanities and Social Science Courses,
  - (b) 1 credits from 500-level courses of Humanities and Social Science Courses,
  - (c) 2 credits from Career Development Courses.
3. Pass the master's thesis review and defense.

Table M1 shows the course categories and number of credits required to complete the master's degree program for this major. It also shows the required minimum credits in each course category and any points to be noted when selecting the required courses and electives.

The learning goals for each course are listed as “associated learning goals.” Prior to registering for a course, students should be sure to fully understand the goals of the course.

**Table M1. Graduate Major in Industrial Engineering and Economics 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	C	
	Career development courses		2 credits		C, D	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar in IEE S1  Seminar in IEE F1  Seminar in IEE S2  Seminar in IEE F2  A total of 8 credits, 2 credits from each of the above courses.		22 credits	A, B, C, D, E	
	Research-related courses	Reading in IEE S  Reading in IEE F  A total of 2 credits, 1 credit from each of the above courses.			A, B, C, E	
	Major courses		12 credits		A, B, C, D, E	
	Major courses and Research-related courses <u>outside</u> of the Graduate Major in Industrial Engineering and					

	<b>Economics standard curriculum</b>					
<b>Total required credits</b>		<b>A minimum of 32 credits including those attained according to the above conditions</b>				
<b>Note</b>		<ul style="list-style-type: none"> <li>• 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.</li> <li>• For details on the Liberal Arts and Basic Science Courses, please refer to the relevant sections.</li> </ul>				

## 5. IGP Courses

Table M2 shows the Core Courses for the Master's Degree Program. 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 for this major.

**Table M2. Core Courses of the Graduate Major in Industrial Engineering and Economics**

Course category		Course number	Course title		Credits	Competencies	Learning goals	Comments
Research seminars	400 level	IEE.Z491.R	◎	Seminar in Industrial Engineering and Economics S1	0-2-0	1,3,5	A,B,C	
		IEE.Z492.R	◎	Seminar in Industrial Engineering and Economics F1	0-2-0	1,3,5	A,B,C	
	500 level	IEE.Z591.R	◎	Seminar in Industrial Engineering and Economics S2	0-2-0	1,3,5	B,C,D,E	
		IEE.Z592.R	◎	Seminar in Industrial Engineering and Economics F2	0-2-0	1,3,5	B,C,D,E	
Research-related courses	400 level	IEE.E401.R	◎	Reading in Industrial Engineering and Economics S	0-1-0	1,3	A,C,E	
		IEE.E402.R	◎	Reading in Industrial Engineering and Economics F	0-1-0	1,3	A,C,E	
	500 level	IEE.E501.L		Academic Presentation in Industrial Engineering and Economics S	0-1-0	2,3	B,E	
		IEE.E502.L		Academic Presentation in Industrial Engineering and Economics F	0-1-0	2,3	B,E	
		IEE.E503		International Workshop Presentation (Abroad)	0-0-1	2,3	B,E	Credits from this course are not included in 22 credits of the core courses required for completion
		IEE.E504		International Workshop Presentation (Domestic)	0-0-1	2,3	B,E	Credits from this course are not included in 22 credits of the core

									courses required for completion
Major courses	400 level	IEE.B401.L			Advanced Microeconomics	2-0-0	1,5	A	
		IEE.B403.L			Advanced Noncooperative Game Theory	2-0-0	1	A	
		IEE.B405.L			Advanced Econometrics	2-0-0	1,5	A	
		IEE.C431.L			Applied Statistical Analysis	2-0-0	1,5	A	
		IEE.C432.L			Applied Cognitive Ergonomics	2-0-0	1,3,4,5	A	
		IEE.D431.L			Distribution and Marketing	2-0-0	1,2,3,5	A	
		IEE.D432.L			Financial Statement Analysis and Valuation	2-0-0	1,2,3,4,5	A	
		IEE.D433.L			Corporate Transformation	2-0-0	1,3	A	
		IEE.D434.L			Corporate Finance and Governance	2-0-0	1,2,3,4,5	A	
		IEE.D435.L			Computers in Society	1-1-0	2,3,4	A	
	500 level								
		IEE.C533.L			Affect in Social Context	2-0-0	1,2,3	A,B	
		IEE.C534.L			Human-Robot Interaction	1-1-0	1,3,4	A,B	
Note :									
• ☉ : Required course, ○ : Restricted elective, O : odd academic years, E : even academic years									
• Competencies: 1 = Specialist skills, 2 = Intercultural skills, 3 = Communication 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 (mathematical engineering), B (economics), C (business administration), D (industrial engineering management technology), E (others), 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 from Career Development Courses, and should also 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 with respect to their GA achievements at the time of their degree completion. For courses with more than one GA, the number of GA for the course is considered acquired on completion of the course, regardless of the credits received for the course itself.

Major Courses that enable students to acquire GA and that are recognized as equivalent to Career Development Courses are listed in Table M3 below. Please note that the credits attained from these courses cannot be counted more than once, e.g., they cannot also be used as credit for the Major Courses or Career Development Courses required for the completion of 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: You will be able to delineate your career plan clearly and recognize the skills necessary to materialize that plan, taking into account its relation to society

C1M: You will be able to understand academic integrity, utilize your own expertise for 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 Industrial Engineering and Economics recognized as equivalent to Career Development Courses**

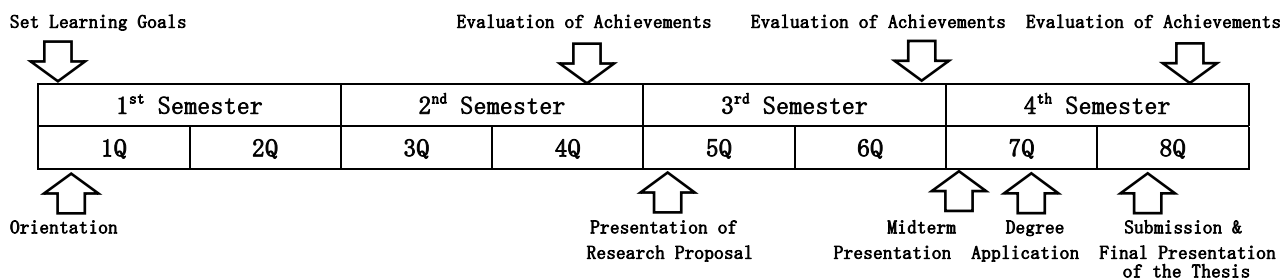
Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	IEE.C433.L			Advanced Course of Management	2-0-0	C0M C1M	A,C,D,E	in Japanese

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. Research Related to the Completion of Master Theses

A master's thesis research project aims to (i) develop fundamental knowledge for comprehending management and economic activities, (ii) the ability to discover new research problems, (iii) the ability to analyze problems and find solutions to those problems, and (iv) the ability to explain, document, and communicate information through a series of research activities. The schedule for the completion of the master's thesis research project is as follows:



### Presentation of Research Proposal and Midterm Presentation

The objectives of these presentations are to enable students to recognize the background and goals of their research from the viewpoint of career development. After presentation of the research proposal, students can apply for 600-level major courses, as long as their academic advisors confirm their progress and allow them to take these courses. Note that credit from 600-level courses is not counted towards the completion requirements for the Master's Degree Program.

### Review Standards for Master Theses

The master's degree thesis should offer new knowledge to the academic fields of industrial engineering and economics or useful knowledge contributing to development of management technologies. Each student should write the thesis on their own, and the thesis should contain their original ideas.

### Methods of Reviewing Master Theses

The thesis committee consists of at least three faculty members. After preliminary reviews of the thesis by the committee, each student gives an oral presentation, and the committee conducts a final review and evaluation of the thesis. (In contrast, the thesis committee for a student applying for the doctoral program should consist of five faculty members.)

## **【Doctoral Degree Program】**

### **1. Outline**

Towards advancing and achieving new knowledge in the fields of industrial engineering and economics, students will develop the ability to identify problems in management, production, or economics from the viewpoints of science and technology, as well as solve essential problems by utilizing approaches from mathematical engineering, economics, business administration, and management techniques. This program aims to cultivate insightful thinkers with the highest level of skill such that they will pursue research on cutting-edge topics in industrial engineering and economics, publish results obtained from their research to international venues, and contribute to society.

### **2. Competencies Developed**

In order to achieve these goal, the doctoral program aims to develop the following competencies at a higher level than the master's degree program:

- Develop the ability to discover and analyze problems in management and economic activities by utilizing mathematical engineering, information, and engineering technologies.
- Develop the ability to propose new solutions for technological, organizational, and economic problems from the viewpoints of industrial engineering and economics.
- Develop the ability to explain, document, and communicate in English or Japanese.
- Achieve the ability to pursue research on new problems and meaningful questions.
- Achieve the ability to publish the results of their research on cutting-edge topics in industrial engineering and economics to academic venues from around the world.
- Develop leadership skills in order to propose and pursue new projects independently.

### **3. Learning Goals**

In order to achieve the competences described above, students will learn the following:

A) Fundamental knowledge in industrial engineering and economics.

Develop the ability to discover, describe, and address problems in management and economic activities by utilizing mathematical, information, and engineering technology.

B) Application of industrial engineering and economics

Develop the ability to propose new solutions for problems in technological, organizational, and economic contexts from the viewpoint of industrial engineering and economics.

C) Broad viewpoints and own initiative for learning

Develop leadership skills in order to propose and pursue novel research projects.

D) Experience of engagement with society

Develop the ability to publish the results of their research on cutting-edge topics in industrial engineering and economics to international venues.

E) Strengthen communication ability

Develop the ability to conduct research on new problems through a doctorate dissertation, as well as the ability to

explain and communicate information in English or Japanese through seminars and presentations.

#### **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 this Graduate Major curriculum:
  - 12 credits acquired from Research Seminars;
  - a minimum of 18 credits acquired from Core Courses; and
  - a minimum of 6 credits acquired from Liberal Arts and Basic Science Courses  
(in particular, the 6 credits should include 2 credits from Humanities and Social Science Courses and 4 credits from Career Development Courses).
3. Pass the doctorate dissertation review, its defense, and the final examination.

Table D1 shows course categories and the number of credits required to complete the doctoral degree program. It also shows the required minimum credits in each course category and any points to be noted when selecting the required courses and electives.

The learning goals to be obtained through each course are listed as “associated learning goals.” Prior to registering for a course, students should be sure to fully understand the goals of the course.

**Table D1. Graduate Major in Industrial Engineering and Economics 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 sciences courses		2 credits	6 credits	C	
	Career development courses		4 credits		C, D	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 IEE S3 Research Seminar in IEE F3 Research Seminar in IEE S4 Research Seminar in IEE F4 Research Seminar in IEE S5 Research Seminar in IEE F5 A total of 12 credits, 2 credits each from the above courses.		18 credits	C, D, E	
	Research-related courses				B, C, D, E	
	Major courses				A, B, C, D, E	
	Major courses and Research-related courses <u>outside</u> of the Graduate Major in Industrial Engineering and Economics standard curriculum					

<b>Total required credits</b>	<b>A minimum of 24 credits including those attained according to the above conditions</b>
<b>Note</b>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.</li> </ul>

## 5. IGP Courses

Table D2 shows the Core Courses for the Doctoral Degree Program. 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.

**Table D2. Core Courses of the Graduate Major in Industrial Engineering and Economics**

<b>Course category</b>	<b>Course number</b>	<b>Course title</b>	<b>Credits</b>	<b>Competencies</b>	<b>Learning goals</b>	<b>Comments</b>
<b>Research seminars</b>	<b>600 level</b>	IEE.Z691.R ◎ Seminar in Industrial Engineering and Economics S3	0-2-0	1,3,5	C,D,E	
		IEE.Z692.R ◎ Seminar in Industrial Engineering and Economics F3	0-2-0	1,3,5	C,D,E	
		IEE.Z693.R ◎ Seminar in Industrial Engineering and Economics S4	0-2-0	1,3,5	C,D,E	
		IEE.Z694.R ◎ Seminar in Industrial Engineering and Economics F4	0-2-0	1,3,5	C,D,E	
		IEE.Z695.R ◎ Seminar in Industrial Engineering and Economics S5	0-2-0	1,3,5	C,D,E	
		IEE.Z696.R ◎ Seminar in Industrial Engineering and Economics F5	0-2-0	1,3,5	C,D,E	
<b>Research-related courses</b>	<b>600 level</b>	IEE.E606.L Industrial Engineering Off-Campus Project S	0-0-2	3,4,5	B,C,D	
		IEE.E607.L Industrial Engineering Off-Campus Project F	0-0-2	3,4,5	B,C,D	
		IEE.E608.L Presentation in Industrial Engineering S	0-2-0	1,3	B,C,E	
		IEE.E609.L Presentation in Industrial Engineering F	0-2-0	1,3	B,C,E	
<b>Major courses</b>	<b>600 level</b>	IEE.E601.L Advanced Course for Educational Practice in Industrial Engineering S	0-2-0	3,5	A,B,C,E	
		IEE.E602.L Advanced Course for Educational Practice in Industrial Engineering F	0-2-0	3,5	A,B,C,E	
		IEE.E603.L Technical Reading in Industrial Engineering	0-2-0	1,3,5	A,B,C,E	

		IEE.E604.L			Practical Training at Companies (Industrial Engineering) S	0-0-3	3,4,5	B,C,D	
		IEE.E605.L			Practical Training at Companies (Industrial Engineering) F	0-0-2	3,4,5	B,C,D	

Note :

- ◎ : Required course, ○ : Restricted elective, O : odd academic years, E : even academic years
- Competencies: 1 = Specialist skills, 2 = Intercultural skills, 3 = Communication 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 (mathematical engineering), B (economics), C (business administration), D (industrial engineering management technology), E (others), R (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 also 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 with respect to their GA achievements at the time of their degree completion. For courses with more than one GA, the number of GA for the course is considered acquired on completion of the course, regardless of the credits received for the course itself.

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. Please note that the credits attained from these courses cannot be counted more than once, e.g., they cannot also be used as Major Courses or Career Development Courses required for the completion of 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 define your own career plan and train yourself to acquire the skills required for attaining your goals in academia

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

A2D: You will be able to understand the position of academia in society as well as the notion of responsible conduct of research, and adequately explain academic progress to members of society, who are our stakeholders

A3D: With the understanding of the social roles and responsibilities of researchers, you will be able to nurture next-generation experts in educational institutions, instilling in them an interest in academia 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 plot your own career plan and train yourself to acquire the skills required for attaining your

goals in industry, etc.

P1D: You will be able to precisely grasp the needs of society and detect its problems, comprehend relevant laws, regulations, or guidelines for responsible conduct of research, and lead 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 society

P3D: With the understanding of the social roles and responsibilities of engineers, you will be able to nurture next-generation experts through the project, enabling them to help drive future development of society and industry.

**Table D3-1. Courses of the Graduate Major in Industrial Engineering and Economics 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	IEE.E606.L		Industrial Engineering Off-Campus Project S	0-0-2	A0D, A1D, A2D, A3D	B,C,D	
	IEE.E607.L		Industrial Engineering Off-Campus Project F	0-0-2	A0D, A1D, A2D, A3D	B,C,D	
	IEE.E608.L		Presentation in Industrial Engineering S	0-2-0	A0D, A1D, A2D, A3D	B,C,E	
	IEE.E609.L		Presentation in Industrial Engineering F	0-2-0	A0D, A1D, A2D, A3D	B,C,E	
	IEE.E604.L		Practical Training at Companies (Industrial Engineering) S	0-0-2	A0D, A3D	B,C,D	
	IEE.E605.L		Practical Training at Companies (Industrial Engineering) F	0-0-2	A0D, A3D	B,C,D	

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

**\* GA: Graduate Attributes**

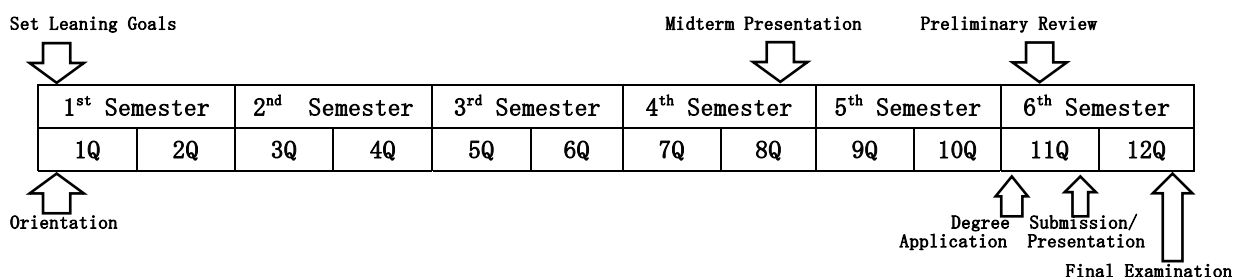
**Table D3-2. Courses of the Graduate Major in Industrial Engineering and Economics recognized as equivalent to Career Development Courses in the Productive Leader Program (PLP)**

Course category	Course number	Course title		Credits	GA*	Learning goals	Comments
<b>Courses that can be counted as Career Development Courses</b>	IEE.E606.L		Industrial Engineering Off-Campus Project S	0-0-2	P0D, P1D, P2D, P3D	B,C,D	
	IEE.E607.L		Industrial Engineering Off-Campus Project F	0-0-2	P0D, P1D, P2D, P3D	B,C,D	
	IEE.E608.L		Presentation in Industrial Engineering S	0-2-0	P2D, P3D	B,C,E	
	IEE.E609.L		Presentation in Industrial Engineering F	0-2-0	P2D, P3D	B,C,E	
	IEE.E604.L		Practical Training at Companies (Industrial Engineering) S	0-0-2	P0D, P1D, P2D, P3D	B,C,D	
	IEE.E605.L		Practical Training at Companies (Industrial Engineering) F	0-0-2	P0D, P1D, P2D, P3D	B,C,D	
<b>Credits in Career Development Courses must be attained from among the above-listed courses or those listed as such in the Liberal Arts and Basic Science Courses Guide.</b> <b>* GA: Graduate Attributes</b>							

Students enrolled in one of the educational programs for leading graduate schools, namely the Tokyo Tech Academy for Leadership (ToTAL) or the Tokyo Tech Academy for Convergence of Materials and Informatics (TAC-MI), 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. Research Related to the Completion of Doctoral Theses

The doctoral thesis research project aims to develop the ability to discover new research problems, the ability to find solutions to these problems, and the ability to explain, document, and communicate information in English. The schedule for completion of the doctoral thesis program is as follows:



### Review Standards for Doctoral Theses

The Doctoral Degree thesis should make a new, original, and sufficient contribution to one or both of the fields of industrial engineering and/or economics. Each student should write the thesis on their own. The major parts of the thesis should be published or publishable in international refereed academic journals.

### Methods of Reviewing Doctoral Theses

The thesis committee consists of at least five faculty members. It is recommended that the committee includes members from outside of Tokyo Tech, such as professors or experienced researchers from other universities, research institutions, or firms. After passing the midterm presentation and preliminary review phase, each student submits their thesis and gives an oral presentation. The committee then conducts the final review and evaluation of their thesis. The final examination includes a reading comprehension test on relevant papers in English in order to confirm the student's ability to comprehend academic materials in their own and related fields.