

Graduate Major in Industrial Engineering and Economics

【Master's Degree Program】

1. Outline

The Master's Degree Program prepares students with fundamental expertise in industrial engineering and economics. To this end, students learn advanced knowledge and skills in the fields of mathematical engineering, economics, business administration, human factors/ergonomics (HF/E), and management techniques. The aims of this program are to cultivate deep insights about technology, organizational structures, and the economy, along with the abilities to discover, investigate, and solve problems in the real world.

2. Competencies Developed

To achieve these educational goals, this program focuses on 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 fundamental 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.
- Develop the ability to pursue research on new problems and questions using a range of methods from fields within industrial engineering and economics.

3. Learning Goals

In developing the competences described above, students will learn the following:

A) Fundamental knowledge in industrial engineering and economics

Learn fundamental knowledge at the graduate level that involves utilizing mathematical, information, and engineering technologies and methods.

B) Application of industrial engineering and economics

Learn the essential knowledge and theory of industrial engineering and economics necessary to understand management activities and develop practical solutions for industrial and economic problems in the information age.

C) Broad perspectives on fundamental topics and an initiative for learning

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

D) Understanding of how to engage with society productively

Experience working within society as a professional, as well as learn engineering ethics through lectures from practitioners and theorists.

E) Strengthened research and communication abilities

Develop the ability to conduct research on new problems or with novel methods, as well as the ability to explain and communicate through a colloquium and research seminars.

4. IGP Completion Requirements

The following requirements must be met 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 credit from 500-level courses of Humanities and Social Science Courses,
- (c) 2 credits from Entrepreneurship 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	
	Entrepreneurship 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 of the</u> Graduate Major in Industrial Engineering and Economics standard curriculum					
Total required credits		A minimum of 32 credits including those attained according to the above conditions				
Note		<ul style="list-style-type: none"> • 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 on the Liberal Arts and Basic Science Courses, please refer to the relevant sections. 				

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	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.A432.L		Advanced Mathematical Programming	2-0-0	1	A	
		IEE.B401.L		Advanced Microeconomics	2-0-0	1,5	A	
		IEE.B402.L		Advanced Macroeconomics	2-0-0	1,2,4	A	
		IEE.B403.L		Advanced Noncooperative Game Theory	2-0-0	1	A	
		IEE.B404.L		Advanced Cooperative Game Theory	2-0-0	1	A	
		IEE.B405.L		Advanced Econometrics	2-0-0	1,5	A	
		IEE.B432.L		Advanced Topics in Macroeconomics	2-0-0	1	A,B	
		IEE.B433.L		Theory and Application of Discrete Optimization	2-0-0	1	A,B	
		IEE.C431.L		Applied Statistical Analysis	2-0-0	1,5	A	
		IEE.C432.L		Cognitive Ergonomics	2-0-0	1,3,4,5	A	Only available for students who have taken this course during their bachelor's program
		IEE.D431.L		Value Creation	2-0-0	1,2,3,5	A	
		IEE.D432.L		Financial Literacy	2-0-0	1,2,3,5	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	1,2,3,4,5	C	
		IEE.D436.L		Healthcare Quality and Safety	2-0-0	1,3,5	A	
	500 level	IEE.C533.L		Affect in Social Context	2-0-0	2,3,4,5	C	
Note : • ⊙ : Required course, ○ : Restricted elective, O : Odd academic years, E : Even academic years								

- Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)
- The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ABC.D400.R): A (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 Entrepreneurship Courses and IGP Courses Counted as Entrepreneurship Courses

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

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

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

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

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.

The Graduate Attributes of the Master's Degree Program are listed in Table M-1 as follows:

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

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

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

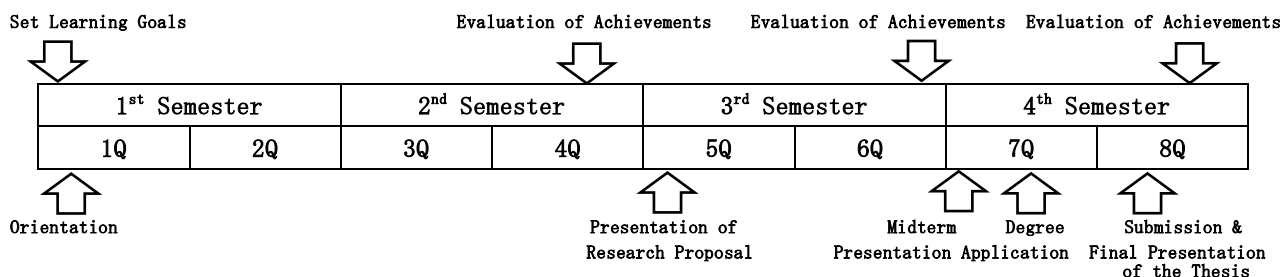
Course category	Course number	Course title		Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	IEE.C433.L		Advanced Course of Management	2-0-0	GA0M, GA1M	A,C,D,E	In Japanese

Entrepreneurship Courses	IEE.E506			Master's Recurrent Program 2 in Industrial Engineering	0-0-2	GA0M GA1M		Entrepreneurship Course offered by the Graduate Major in Industrial Engineering and Economics. (Cannot be counted for Major Courses)
Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide. * GA: Graduate Attribute(s)								

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

8. Research Related to the Completion of Master's 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 research findings. 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 perspective 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 the 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

The Doctoral Degree Program enables students to attain advanced knowledge and expertise in industrial engineering and economics and actively contribute research of scientific and societal significance within these disciplines. To this end, students specialize in an area of study related to mathematical engineering, economics, business administration, human factors/ergonomics (HF/E), and management. This program aims to cultivate insightful thinkers with the highest level of skill education can provide, such that they will pursue research on cutting-edge topics in industrial engineering and economics, publish results obtained from their research to international, peer-reviewed venues, and contribute practically to society.

2. Competencies Developed

To achieve these goals, the doctoral program focuses on 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.
- Achieve the ability to pursue research on new problems and meaningful questions using a range of methods from fields within industrial engineering and economics.
- Achieve the ability to publish the results of their research on cutting-edge topics in industrial engineering and economics to international, peer-reviewed academic venues.
- Develop leadership skills that enable the learner to propose and pursue new projects independently.

3. Learning Goals

In achieving 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 technologies and methods.

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 perspectives on fundamental topics and an initiative for learning

Develop leadership skills to propose and pursue novel research projects.

D) Experience of engaging with society

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

E) Strengthened research and communication abilities

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

explain and communicate through research 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 Entrepreneurship 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	
	Entrepreneurship 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					
Total required credits		A minimum of 24 credits including those attained according to the above conditions				
Note		<ul style="list-style-type: none"> • 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 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

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research-related courses	600 level	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	
	600 level	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	
Major courses	600 level	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	
		IEE.B632.L			Cooperative Education through Research Internships of Industrial Engineering and Economics	0-0-4	3,4,5	B,C,D	
Note : <ul style="list-style-type: none">⊙ : Required course, ○ : Restricted elective, O : Odd academic years, E : Even academic yearsCompetencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)The character preceding the three digits in the course number denotes the course’s subdiscipline (i.e., “D” represents the subdiscipline code in the course number ABC.D600.R): A (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 Entrepreneurship Courses and IGP Courses Counted as Entrepreneurship Courses

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

acquired if students attain the corresponding credits for those courses.

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

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

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

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.

The Graduate Attributes of the Doctoral Degree Program are listed in Table D-1 as follows:

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

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

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

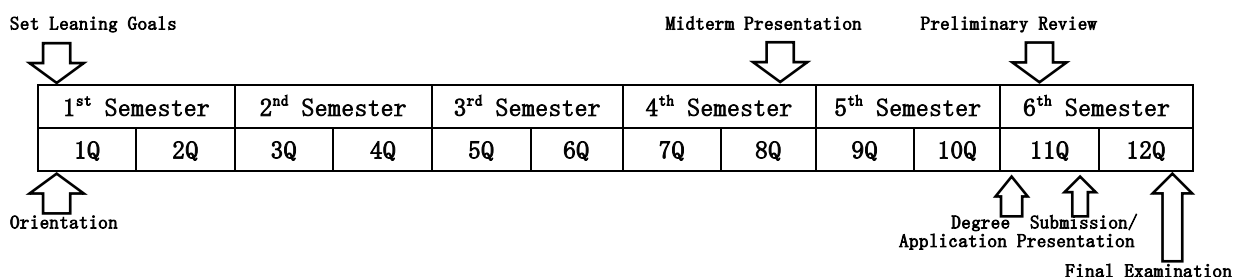
Course category	Course number	Course title		Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	IEE.E606.L		Industrial Engineering Off-Campus Project S	0-0-2	GA0D,GA1D	B,C,D	
	IEE.E607.L		Industrial Engineering Off-Campus Project F	0-0-2	GA0D,GA1D	B,C,D	
	IEE.E608.L		Presentation in Industrial Engineering S	0-2-0	GA0D,GA1D	B,C,E	
	IEE.E609.L		Presentation in Industrial Engineering F	0-2-0	GA0D,GA1D	B,C,E	
	IEE.E604.L		Practical Training at Companies (Industrial Engineering) S	0-0-2	GA0D,GA1D	B,C,D	
	IEE.E605.L		Practical Training at Companies (Industrial Engineering) F	0-0-2	GA0D,GA1D	B,C,D	
	IEE.B632.L		Cooperative Education through Research Internships of Industrial Engineering and Economics	0-0-4	GA1D	B,C,D	
Entrepreneurship Courses	IEE.E610		Doctoral Recurrent Program 4 in Industrial Engineering	0-0-4	GA0D, GA1D		Entrepreneurship Course offered by the Graduate Major in Industrial Engineering and Economics. (Cannot be counted for Major

							Courses)
Credits in Entrepreneurship 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							

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

8. Research Related to the Completion of Doctoral Theses

The doctoral thesis research project aims to develop the abilities to discover new research problems, find solutions to these problems, and explain, document, and communicate information. 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. The committee should include 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 to confirm the student's ability to comprehend academic material in their own and related fields and engage with the international community on their topic of study.