Graduate Major in Industrial Engineering and Economics

【Master's Degree Program】

1. Outline

Based on the fundamental knowledge in industrial engineering and economics, students learn advanced knowledge and skills in mathematical engineering, economics, business administration, and industrial engineering management technology fields. This program aims to cultivate people with deep insights in technology, organization and economy, and with abilities to identify, inquire, and resolve problems in the world.

2. Competencies Developed

In order to pursue the course goal, this program aims to develop the following competencies.

・Fundamental knowledge to freely utilize mathematical engineering, information, and engineering technologies.

・Knowledge and viewpoints of industrial engineering and economics in order to comprehend management activities and programs in economics.

・Ability for deeper insight in technology and organization, and for discovering, analyzing and solving essential problems.

・Conceptual ability for structuring and modeling problems.

・Ability in explaining, documenting and communicating in English or Japanese language.

・Ability to pursue researches towards new problems.

3. Learning Goals

In order to develop the competences described above, students learn the following in this program.

A) Fundamental knowledge in industrial engineering and economics.

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

B) Application of industrial engineering and economics

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

C) Broad viewpoints and own initiative for learning

Develop insights on technology and organization, ability for discovering, analyzing, and solving essential problems, as well as conceptual ability for structuring and modeling problems.

D) Experience of engagement with society

Pseudo-experience engagement with society and learning of engineering ethics through lectures by practitioners.

E) Strengthen communication ability

Develop ability to conduct research on new problems through research projects for master thesis, and ability for explaining and communicating information in English/Japanese languages through colloquium and seminars.

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 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

    (3 credits from Humanities and Social Science Courses of which 2 credits must be from 400-level courses and 1 credit from 500-level courses, and 2 credits 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 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 each from 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 each from 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> the 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		**・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 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	2,3,5	A,B,C	
		IEE.Z492.R	◎		Seminar in Industrial Engineering and Economics F1	0-2-0	2,3,5	A,B,C	
	500 level	IEE.Z591.R	◎		Seminar in Industrial Engineering and Economics S2	0-2-0	2,3,5	B,C,D,E	
		IEE.Z592.R	◎		Seminar in Industrial Engineering and Economics F2	0-2-0	2,3,5	B,C,D,E	
Research-related courses	**400 level**	IEE.E401.R	◎		Reading in Industrial Engineering and Economics S	0-1-0	2,3	A,C,E	
		IEE.E402.R	◎		Reading in Industrial Engineering and Economics F	0-1-0	2,3	A,C,E	
	500 level	IEE.E501.L			Academic Presentation in Industrial Engineering and Economics S	0-1-0	1,2	B,E	
		IEE.E502.L			Academic Presentation in Industrial Engineering and Economics F	0-1-0	1,2	B,E	
		IEE.E503			International Workshop Presentation (Abroad)	0-0-1	1,2	B,E	Credits from this course are not included in 22 credits of core courses required for completion
		IEE.E504			International Workshop Presentation (Domestic)	0-0-1	1,2	B,E	Credits from this course are not

									included in 22 credits of core courses required for completion
Major courses	**400 level**	IEE.C432.L			Applied Cognitive Ergonomics	2-0-0	2,3,4,5	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	2,3	A	☐
		IEE.D434.L			Corporate Finance and Governance	2-0-0	1,2,3,4, 5	A	☐
	500 level	IEE.C501.L			Design Thinking	1-1-0	1,2,4,5	B,C,D,E	☐
		IEE.C530.L			Design Business	1-1-0	1,2,3,4, 5	B	☐
		IEE.C531.L			Enterprise Engineering	2-0-0	2,3,4	B	☐

Note：

- ◎：Required course, ○：Restricted elective, O：odd academic years, E：even academic years
- ☐：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
- 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 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 Industrial Engineering and Economics recognized as equivalent to Career Development Courses

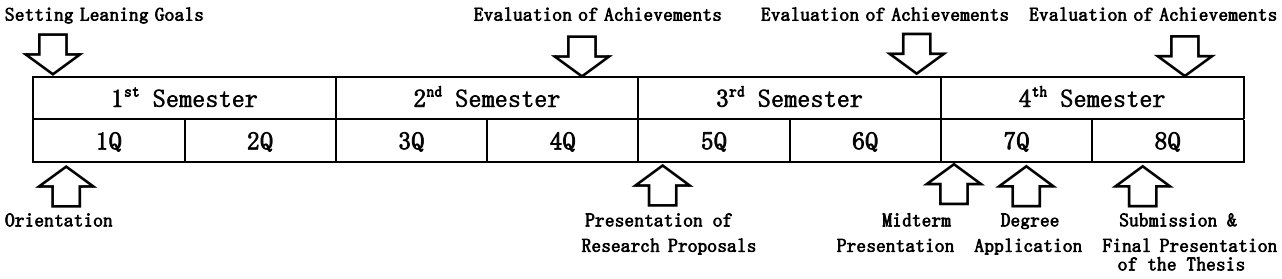
Course category	**Course number**	**Course title**			**Credits**	**GA***	**Learning goals**	**Comments**
Courses that can be counted as Career Development Courses	IEE.C433.L			Advanced Course of Management	2-0-0	C0M C1M	A,C,D,E	
	IEE.C532.L			Management of Technology and Intellectual Property	2-0-0	C1M	B,C,D	

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

Master thesis research aims to develop fundamental knowledge to comprehend management and economic activities, ability to find new research problems, ability to analyze problems and find solutions, and ability in explaining, documenting and communicating information through a series of research activities. The schedule for the completion of the master thesis is given as follows:



Presentation of Research Proposals and Midterm Presentation

The objectives of these presentations are to enable students to recognize backgrounds and goals of their own researches from the viewpoint of career development. After presentations of research proposals, students can apply for 600-level major courses if their academic advisors confirm their progresses and admit taking these courses. However, notice that any credit of 600-level course is not counted in completing requirements for the Master's Degree Program of this major.

Review Standards for Master Theses

The Master's Degree thesis of this major should include new knowledge in academic fields of industrial engineering and economics or useful knowledge to contribute developments of management technologies. Each student should write his or her thesis by him or herself and the thesis should contain his or her original ideas.

Methods of Reviewing Master Theses

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

【Doctoral Degree Program】

1. Outline

Based on the advanced and latest knowledge in industrial engineering and economics, students develop ability to identify problems in management, production, or economics from the viewpoint of science and technology, and solve the problems utilizing approaches of mathematical engineering, economics, business administration, and industrial engineering management technology. This program aims to cultivate people with abilities to pursue researches on cutting-edge topics in industrial engineering and economics, to publish results obtained from research to the world, and to contribute to the society.

2. Competencies Developed

In order to pursue the course goal, this program aims to develop the following competencies at higher levels than the master's degree program.

・Ability to find and analyze problems in management and economic activities utilizing mathematical engineering, information, and engineering technologies.

・Ability to propose new solutions for technological, organizational, and economic problems from the viewpoints of industrial engineering and economics.

・Ability in explaining, documenting and communicating in English or Japanese language.

・Ability to pursue researches towards new problems.

・Ability to publish results of researches on cutting-edge topics in industrial engineering and economics to the world.

・Leadership to propose and pursue projects.

3. Learning Goals

In order to develop the competences described above, students learn the following in this program.

A) Fundamental knowledge in industrial engineering and economics.

Develop ability to discover, analyze problems in management and economic activities utilizing mathematical, information, and engineering technology.

B) Application of industrial engineering and economics

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

C) Broad viewpoints and own initiative for learning

Develop leadership to propose and pursue projects.

D) Experience of engagement with society

Develop ability to publish results of researches on cutting-edge topics in industrial engineering and economics to the world.

E) Strengthen communication ability

Develop ability to conduct research on new problems through research projects for doctorate dissertation, and ability for explaining and communicating information in English/Japanese languages through seminars.

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

      (2 credits from Humanities and Social Science Courses, and 4 credits from Career Development Courses).
3. Pass the doctorate dissertation review, its defense, and final examination.

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 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 outside 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	・Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level. ・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.

5. IGP Courses

Table D2 shows the Core Courses of the Doctoral Degree Program of this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

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

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	600 level	IEE.Z691.R	◎		Seminar in Industrial Engineering and Economics S3	0-2-0	2,3,5	C,D,E	
		IEE.Z692.R	◎		Seminar in Industrial Engineering and Economics F3	0-2-0	2,3,5	C,D,E	
		IEE.Z693.R	◎		Seminar in Industrial Engineering and Economics S4	0-2-0	2,3,5	C,D,E	
		IEE.Z694.R	◎		Seminar in Industrial Engineering and Economics F4	0-2-0	2,3,5	C,D,E	
		IEE.Z695.R	◎		Seminar in Industrial Engineering and Economics S5	0-2-0	2,3,5	C,D,E	
		IEE.Z696.R	◎		Seminar in Industrial Engineering and Economics F5	0-2-0	2,3,5	C,D,E	
Research-related courses	600 level	IEE.E606.L			Industrial Engineering Off-Campus Project S	0-0-2	2,4,5	B,C,D	
		IEE.E607.L			Industrial Engineering Off-Campus Project F	0-0-2	2,4,5	B,C,D	
		IEE.E608.L			Presentation in Industrial Engineering S	0-2-0	1,2	B,C,E	
		IEE.E609.L			Presentation in Industrial Engineering F	0-2-0	1,2	B,C,E	
Major courses	600 level	IEE.E601.L			Advanced Course for Educational Practice in Industrial Engineering S	0-2-0	2,5	A,B,C,E	
		IEE.E602.L			Advanced Course for Educational Practice in Industrial Engineering F	0-2-0	2,5	A,B,C,E	
		IEE.E603.L			Technical Reading in Industrial Engineering	0-2-0	2,3,5	A,B,C,E	
		IEE.E604.L			Practical Training at Companies (Industrial Engineering) S	0-0-2	2,4,5	B,C,D	

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

Note：

• ◎：Required course，○：Restricted elective，O：odd academic years，E：even academic years

• □：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

• 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 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 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 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 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
Courses that can be counted as Career Development Courses	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	

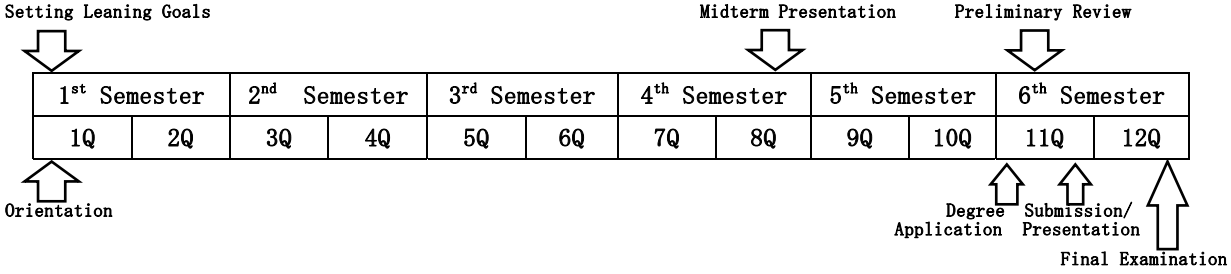
Credits in Career Development Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

＊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. Research Related to the Completion of Doctoral Theses

Doctoral thesis research aims to develop ability to find new research problems, ability to find solutions to problems, and ability in explaining, documenting and communicating information in English. The schedule for the completion of the doctoral thesis is given as follows:



Review Standards for Doctoral Theses

The Doctoral Degree thesis of this major should make new, original and sufficient contributions to the fields of industrial engineering and/or economics. Each student should write his or her thesis by him or herself and 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 positively includes members outside Tokyo Tech such as in universities, research institutions, and firms. After passing the midterm presentation and preliminary review, each student submits the thesis and gives an oral presentation, and the committee conducts the final review and evaluation of the thesis. The final examination includes a reading comprehension test on related articles in English in order to confirm abilities in comprehending academic materials in related fields.