Graduate Major in Electrical and Electronic Engineering

The department of electrical and electronic engineering offers a broad range of advanced courses as well as fundamental subjects in the field of electrical and electronic engineering. These courses cover basic topics necessary to understand the electrical and electronic engineering, which provide the state-of-the-art science and technology in the fields of “electronic materials,” “electron devices,” “wave, photonics and communication,” “electronic circuit,” and “power, energy and environment” and pragmatical courses, in which students acquire the practical skills of electrical and electronic engineering. Along with master’s and doctoral research activities, students are expected to enhance the ability to identify and resolve problems.

【Master's Degree Program】

1. Outline

The aim of this program is to foster researchers and engineers able to play a global active role with fundamental understanding, ability of application and development, and originality through the course work and research project in the field of electrical and electronic engineering, mainly focused on the social infrastructure, such as “electronic materials,” “electron devices,” “wave, photonics and communication,” “electronic circuit,” and “power, energy and environment.”

2. Competencies Developed

This graduate major expects students in the master’s degree program to acquire the following abilities:

- Basic expertise acquisition to understand essentials in the field of electrical and electronic engineering.
- Problem setting and solving abilities in the interdisciplinary research fields.
- Maneuvering ability to solve problems and to propose creative proposals in the field of electrical and electronic engineering with the basic and expertise acquisition.
- Ability to perform research projects with understating of future trends from a global point of view.
- Ability for communication and documentation with logical explanation.

3. Learning Goals

In this master’s degree program, each student is required to study the following contents, in order to obtain the abilities mentioned above.

A) Basic expertise acquisition
Study necessary basics for understanding research fields of “electronic materials,” “electron devices,” “wave, photonics and communication,” “electronic circuit” and “power, energy and environment.”

B) High expertise in the above fields and adaptivity to interdisciplinary research areas
Broaden the knowledge of the above research fields to cultivate the ability to solve problems in interdisciplinary research areas around electrical and electronic engineering.

C) Ability to identify and solve problems and master’s thesis research
Students are expected to acquire the ability of problem identification and solution through the own research project for

master’s thesis.

D) Acquisition of creativity and practical research ability
Students are expected to learn how to conduct their research projects proactively. For this purpose, it is required to realize their inventive ideas in the master’s thesis project and research courses and to make presentation and discussion in technical conferences and/or workshops.

E) Ability of logical explanation in communication and documentation
Acquire the ability of logical explanation and communication to exchange the own view, idea, and opinion with researchers and/or engineers in various research fields through the own master’s thesis project and/or research courses.

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. Fulfill requirements in Table M1 below.
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 Electrical and Electronic Engineering 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	B, E	
	Career development Courses		2 credits		C, D, E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar S1 on Electrical and Electronic Engineering Seminar F1 on Electrical and Electronic Engineering Seminar S2 on Electrical and Electronic Engineering Seminar F2 on Electrical and Electronic Engineering A total of 8 credits, 2 credits each from the above courses.			A, B, C, D, E	
	Research-related courses				B, D, E	
	Major courses		13 credits		A, B	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Electrical and Electronic				B, E	

	Engineering 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 Electrical and Electronic Engineering

Course category		**Course number**	**Course title**			**Credits**	**Competencies**	**Learning goals**	**Comments**
Research seminars	**400 level**	EEE.Z491.R	◎		Seminar S1 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z492.R	◎		Seminar F1 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
	500 level	EEE.Z591.R	◎		Seminar S2 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z592.R	◎		Seminar F2 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
Research-related courses	**500 level**	EEE.R551.L		★	Study Abroad (Master Course) A	0-0-1	2,3,5	B,E	
		EEE.R552.L		★	Study Abroad (Master Course) B	0-0-2	2,3,5	B,E	
		EEE.R553.L		★	Study Abroad (Master Course) C	0-0-4	2,3,5	B,E	
		EEE.R554.L		★	Study Abroad (Master Course) D	0-0-6	2,3,5	B,E	
		EEE.R561.L			Internship (Master Course) A	0-0-1	2,3,5	D,E	
		EEE.R562.L			Internship (Master Course) B	0-0-2	2,3,5	D,E	
		EEE.R563.L			Internship (Master Course) C	0-0-4	2,3,5	D,E	
		EEE.R564.L			Internship (Master Course) D	0-0-6	2,3,5	D,E	

Major courses	**400 level**	EEE.C401.L		★	Analog Integrated Circuits	2-0-0	1,4,5	A	【Information and Communications Engineering】(ICT.I408)
		EEE.G402.L		★	Scientific Writing and Presentation Skills	2-0-0	3,4	A	【School of Engineering】(XEG.G401)
		EEE.C441.L		★	VLSI Technology I	2-0-0	1	A	
		EEE.C442.L		★	VLSI Technology II	1-0-0	1,5	A	
		EEE.C443.L		★	Topics in Digital VLSI Design	1-0-0	1	A,B	【School of Engineering】(XEG.S405)
		EEE.C451.L			RF Measurement Engineering	1-0-1	1,5	A	
		EEE.C471.L		★	Graph Theory with Engineering Application	1-0-0	1	A,B	【School of Engineering】(XEG.S404)
		EEE.C461.L		★	VLSI System Design	2-0-0	1,4,5	A	【Information and Communications Engineering】(ICT.I415)
		EEE.D401.L		★	Fundamentals of Electronic Materials	2-0-0	1,5	A	
		EEE.D407.L		★	Advanced Nano Science	2-0-0	1,2,4,5	B	【Chemical Science and Engineering】(CAP.P494)
		EEE.D411.L		★	Semiconductor Physics	2-0-0	1,5	A	
		EEE.D416.L		★	Advanced Course of Quantum Chemistry	2-0-0	1,5	B	【Materials Science and Engineering】(MAT.M421)
		EEE.D421.L		★	Imaging Materials	2-0-0	1,5	A	
		EEE.D431.L		★	Fundamentals of Light and Matter I	2-0-0	1	A	
		EEE.D441.L		★	Information Storage Engineering	2-0-0	1,2,3,4,5	A	
		EEE.D442.L		★	Special Seminar on Semiconductor Memory	1-0-0	1,2,5	A	

		EEE.D451.L		★	Bipolar Transistors and Compound Semiconductor Devices	2-0-0	1,5	A	
		EEE.D452.L		★	Special Topics on Semiconductor Devices and Applications	3-0-0	1	A	This will be held at National Chiao Tung University, Taiwan.
		EEE.D461.L			Optoelectronics	2-0-0	1,4,5	A	
		EEE.D481.L			Advanced Power Semiconductor Devices	2-0-0	1,4,5	A	
		EEE.D491.L		★	Introduction to Photovoltaics	2-0-0	1,5	A	【Energy Science and Engineering】(ENR.L410)
		EEE.D492.L		★	Soft Materials	2-0-0	1,2,3,5	B	【Materials Science and Engineering】(MAT.P483)
		EEE.G401.L			Utilization of Intelligent Information Resources and Patents	1-0-0	1,5	A	
		EEE.G411.L			Electrical Modeling and Simulation	2-0-0	1,5	A	
		EEE.P402.L		★	Control and Analysis of Power and Motor Drive Systems	1-0-0	1,5	A	
		EEE.P412.L		★	Power Electronics Circuit and Systems	1-0-0	1,5	A	
		EEE.P413.L		★	Power Electronics Application to Power Systems	1-0-0	1,5	A	
		EEE.P414.L		★	Power Electronics control and analysis	1-0-0	1,5	A	
		EEE.P421.L			Advanced Electric Power Engineering	1-0-0	1,3	A	
		EEE.P451.L		★	Plasma Engineering	2-0-0	1	A	
		EEE.P461.L		★	Pulsed Power Technology	2-0-0	1,4,5	A	
		EEE.R411.L		★	International Communication I	0-1-0	2,3	B,E	
		EEE.R412.L		★	International Communication II	0-1-0	2,3	B,E	
		EEE.R421.L		★	Academic Presentation I	0-1-0	1,3	D,E	
		EEE.R422.L		★	Academic Presentation II	0-1-0	1,3	D,E	

		EEE.S401.L		★	Advanced Electromagnetic Waves	2-0-0	1,5	A	
		EEE.S411.L		★	Guided Wave Circuit Theory	1-0-0	1,5	A	
		EEE.S451.L		★	Wireless Communication Engineering	2-0-0	1,5	A	
		EEE.S461.L		★	Optical Communication Systems	2-0-0	1,5	A	
		EEE.Z471.L		★	Seminar for Cultivating International Understanding I	0-2-0	2,3	B,E	
		EEE.Z472.L		★	Seminar for Cultivating International Understanding II	0-1-0	2,3	B,E	
		EEE.D406.L		★	Advanced Solid State Physics	2-0-0	1,5	B	【Materials Science and Engineering】(MAT.M407)
		EEE.D446.L		★	Characterization of Nanomaterials	2-0-0	1	B	【Materials Science and Engineering】(MAT.M402)
		EEE.D447.L		★	Materials Simulation	2-0-0	1,5	B,C	【Tokyo Tech Academy for Convergence of Materials and Informatics】(TCM.A402)
		EEE.D449.L		★	Materials Informatics	2-0-0	1,5	B,C	【Tokyo Tech Academy for Convergence of Materials and Informatics】(TCM.A404)
		EEE.E401.L		★ #	Interdisciplinary principles of energy devices 1	1-0-0	1,5	A,C	【Energy Science and Engineering】（ENR.A403）#
		EEE.E402.L		★ #	Interdisciplinary principles of energy devices 2	1-0-0	1,4,5	A,C	【Energy Science and Engineering】（ENR.A404）#

		EEE.E403.L		★ #	Energy system theory	1-0-0	1,4	A,C	【Energy Science and Engineering】（ENR.A407）#
	500 level	EEE.D501.L		★	Dielectric Property and Organic Devices	2-0-0	1	B	
		EEE.D511.L		★	Magnetism and Spintronics	2-0-0	1,5	B	
		EEE.D521.L		★	Advanced Materials in Information Technologies	2-0-0	1,5	B	
		EEE.D531.L		★	Fundamentals of Light and Matter IIa	1-0-0	1,5	B	
		EEE.D532.L		★	Fundamentals of Light and Matter IIb	1-0-0	1	B	
		EEE.D533.L		★	Fundamentals of Light and Matter IIc	1-0-0	1	B	
		EEE.D551.L		★	Nano-Structure Devices	2-0-0	1,5	B	
		EEE.D571.L		★	Nano-Materials Electronics	2-0-0	1,4	B	
		EEE.D581.L		★	Advanced functional electron devices	2-0-0	1,2,3,4,5	B	【Energy Science and Engineering】(ENR.L530)
		EEE.D592.L		★	Advanced Topics on Material Analysis and Basics of Plasma Processing for Nano Devices	2-0-0	1	B	
		EEE.P501.L		★	Magnetic Levitation and Magnetic Suspension	2-0-0	1	B	
		EEE.R511.L		★	International Communication III	0-1-0	2,3	B,E	
		EEE.R512.L		★	International Communication IV	0-1-0	2,3	B,E	
		EEE.R521.L		★	Academic Presentation III	0-1-0	1,3	D,E	
		EEE.R522.L		★	Academic Presentation IV	0-1-0	1,3	D,E	
		EEE.S551.L		★	Introduction to Information and Communication Technologies for Development	1-0-0	1	B	【Global Engineering for Development, Environment and Society】(GEG.T501)

		EEE.S571.L		★	AI & network communication systems	1-0-0	1	B	

Note：

• ◎: Required course, ○: Restricted elective, ★: Classes in English, O: odd academic years, E: even academic years., # : Priority for students in Tokyo Tech Academy of Energy and Informatics Program

• 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).

• 【 】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 (Electronic Circuit), D (Electron Devices and Electronic Materials), P (Electric Power, Energy, and Environment), S (Wave, Photonics, and Communication), G (General Subjects), R (Off-Campus Projects), and 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 can be counted towards the completion requirements of master's degree program, either for the Major Courses or for the Career Development Courses (i.e., not for both). Nevertheless, even in the cases from those mentioned above where attained credits pertaining to these courses are not considered as Career Development Courses, their associated GAs are always considered to have been acquired.

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:

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, and ethics 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 Electrical and Electronic Engineering 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	EEE.R551.L		★	Study Abroad (Master Course) A	0-0-1	GA1M	B,E	
	EEE.R552.L		★	Study Abroad (Master Course) B	0-0-2	GA1M	B,E	
	EEE.R553.L		★	Study Abroad (Master Course) C	0-0-4	GA1M	B,E	
	EEE.R554.L		★	Study Abroad (Master Course) D	0-0-6	GA1M	B,E	
	EEE.R561.L			Internship (Master Course) A	0-0-1	GA1M	D,E	
	EEE.R562.L			Internship (Master Course) B	0-0-2	GA1M	D,E	
	EEE.R563.L			Internship (Master Course) C	0-0-4	GA1M	D,E	
	EEE.R564.L			Internship (Master Course) D	0-0-6	GA1M	D,E	
	EEE.G401.L			Utilization of Intelligent Information Resources and Patents	1-0-0	GA1M	A	

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

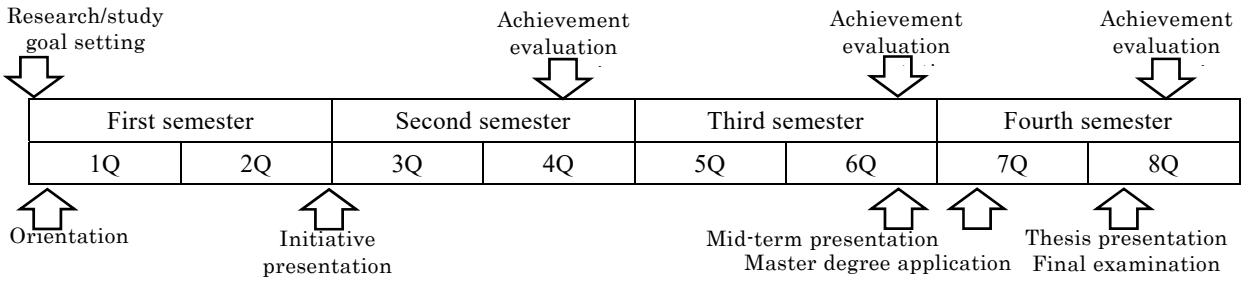
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Common courses	Utilization of Intelligent Information Resources and Patents (2)			Scientific Writing and Presentation Skills (2)	©Master Thesis Research Project			
	Electrical Modeling and Simulation (2)			Introduction to Information and Communication Technologies for Development (1)				
Wave, photonics, communication courses	Advanced Electromagnetic Waves (2)	Wireless Communication Engineering (2)	Guided Wave Circuit Theory (2)	Optical Communication Systems (2)				
		RF Measurement Engineering (2)						
Power, energy, environment courses	Advanced Electric Power Engineering (1)	Power Electronics Circuits and Systems (1)	Power Electronics Application to Power Systems (1)	Power Electronics Control and Analysis (1)				
	Plasma Engineering (2)		Control and analysis of power and motor drive systems (1)					
			Magnetic Levitation and Magnetic Suspension (2)					
			Pulsed Power Technology (2)					
Electronic circuit courses	VLSI Technology I (2)	VLSI Technology II (1)	VLSI System Design (2)					
		Analog Integrated Circuits (2)	Special Seminar on Semiconductor Memory (1)					
			Advanced Topics on Material Analysis and Basics of Plasma Processing for Nano Devices (2)					
Electron devices courses	Bipolar Transistors and Compound Semiconductor Devices (2)	Semiconductor Physics (2)	Optoelectronics (2)	Advanced Functional Electron Devices (2)				
Electronic materials courses	Fundamentals of Light and Matter I (2)	Introduction to Photovoltaics (2)	Imaging Materials (2)	Advanced Materials in Information Technologies (2)				
	Fundamentals of Electronic Materials (2)	Fundamentals of Light and Matter Ia (1)	Magnetism and Spintronics (2)	Nano-Structure Devices (2)				
		Fundamentals of Light and Matter Ib (1)	Nano-Materials Electronics (2)	Information Storage Engineering (2)				
		Fundamentals of Light and Matter Ic (1)	Dielectric Property and Organic Devices (2)					
Research seminars	◎ Seminar S1 on Electrical and Electronic Engineering (2)		◎ Seminar F1 on Electrical and Electronic Engineering (2)		◎ Seminar S2 on Electrical and Electronic Engineering (2)		◎ Seminar F2 on Electrical and Electronic Engineering (2)	
	Study Abroad/Internship	Study Abroad/Internship	Study Abroad/Internship	Study Abroad/Internship				

9. Example of a Standard Curriculum

	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Common courses	Utilization of Intelligent Information Resources and Patents (2) Electrical Modeling and Simulation (2)			Scientific Writing and Presentation Skills (2) Introduction to Information and Communication Technologies for Development (1)	◎Master Thesis Research Project			
Wave, photonics, communication courses	Advanced Electromagnetic Waves (2)	Wireless Communication Engineering (2) RF Measurement Engineering (2)	Guided Wave Circuit Theory (2) AI & Network Communication System (1)	Optical Communication Systems (2)				
Power, energy, environment courses	Plasma Engineering (2)	Power Electronics Circuits and Systems (1)	Power Electronics Application to Power Systems (1) Control and analysis of power and motor drive systems (1) Magnetic Levitation and Magnetic Suspension (2) Pulsed Power Technology (2) Advanced Electric Power Engineering (1)	Power Electronics Control and Analysis (1)				
Electronic circuit courses	VLSI Technology I (2)	VLSI Technology II (1) Analog Integrated Circuits (2)	VLSI System Design (2) Special Seminar on Semiconductor Memory (1) Advanced Topics on Material Analysis and Basics of Plasma Processing for Nano Devices (2)					
Electron devices courses	Bipolar Transistors and Compound Semiconductor Devices (2)	Semiconductor Physics (2)	Optoelectronics (2)	Advanced Functional Electron Devices (2)				
Electronic materials courses	Fundamentals of Light and Matter I (2) Fundamentals of Electronic Materials (2)	Introduction to Photovoltaics (2) Fundamentals of Light and Matter Ia (1) Fundamentals of Light and Matter Ib (1) Fundamentals of Light and Matter Ic (1)	Imaging Materials (2) Magnetism and Spintronics (2) Nano-Materials Electronics (2) Dielectric Property and Organic Devices (2)	Advanced Materials in Information Technologies (2) Nano-Structure Devices (2) Information Storage Engineering (2)				
Research seminars	◎ Seminar S1 on Electrical and Electronic Engineering (2)		◎ Seminar F1 on Electrical and Electronic Engineering (2)		◎ Seminar S2 on Electrical and Electronic Engineering (2)		◎ Seminar F2 on Electrical and Electronic Engineering (2)	
	Study Abroad/Internship	Study Abroad/Internship	Study Abroad/Internship	Study Abroad/Internship				

10. Research Related to the Completion of Master Theses

Our master research project aims to improve the problem setting and solving abilities and communication and presentation skills through experience of a series of study and research processes. Fig. 1 shows the standard study and research flow to achieve the above aim. Each student confirms own study/research plan and its effectiveness in every semester through interviews with the academic supervisor and/or advisor, and then, records the self-evaluation and the review result from the advisors on study and research achievements. In initiative, mid-term, and thesis presentations, it is expected to improve not only the presentation and communication skills but also the ability for practical problem solution with the help of the comments and suggestions from the supervisor and/or other faculties. These study/research activities toward the master degree achieve acquisition of the abilities "to identify and solve problems" and "creativity and practical research ability" as presented in the items C and D of the aforementioned "Learning Goals."



App.Fig.1 A standard flow for the master degree in the Graduate Major in Electrical and Electronic Engineering.

Initiative presentation and mid-term presentation

The initiative presentation aims to develop students' clear awareness of research background, objective, motivation, and so on in their own master thesis research project. It is held in the third quarter after their admission. The mid-term presentation is held in the sixth quarter to confirm the progress of their research project. After the initiative presentation, the student should submit a course work study plan to the faculty for the graduate major. And then, the student can register 600-level research-related courses and major courses which is mainly for doctoral program students, with the allowance of the faculty. It should be noted that 600-level courses are excluded from the master program completion requirements as shown in Table M1.

Master thesis criteria

Master thesis for this graduate major should be an article written by the student him/her-self. The thesis should be able to present original considerations and/or discussions, including a new knowledge in the academic field of electrical and electronics engineering or a usefulness contributing to the evolution of electrical and electronics technology. Thesis abstract should be written in English.

Master thesis examination procedure

The committee for master thesis examination consists of three or more examiners. Each student has to make a thesis presentation after the examiners' review of the submitted master thesis. The committee decides the final evaluation based on the thesis review and presentation. Five or more examiners will review and evaluate the master thesis in case of students who wish to enter the doctoral degree program.

【Doctoral Degree Program】

1. Outline

The aim of this program is to foster researchers and engineers able to play an active role as a global leader with fundamental understanding, ability of application and development, originality, and international communication skills through the course work and research project in the field of electrical and electronic engineering, mainly focused on the social infrastructure, such as "electronic materials," "electron devices," "wave, photonics and communication," "electronic circuit," and "power, energy and environment."

2. Competencies Developed

This doctoral degree program expects students to acquire the following abilities at a higher level than the master's degree program:

- Cutting-edge expertise acquisition to understand essentials in the field of electrical and electronic engineering.
- Problem setting and solving ability in the interdisciplinary research fields.
- Maneuvering ability to solve problems and to propose creative proposals in the field of electrical and electronic engineering with the basic and expertise acquisition.
- Ability to perform research projects with understating of future trends from a global point of view.
- Ability for communication and documentation with logical explanation.

3. Learning Goals

In this doctoral degree program, each student is required to study the following contents, in order to obtain the abilities mentioned above.

A) Cutting-edge expertise acquisition
To study the cutting-edge expertise to understand the essentials in a specific field of "electronic materials," "electron devices," "wave, photonics and communication," "electronic circuit" or "power, energy and environment."

B) Understanding of interdisciplinary research areas and practical ability to solve technical problems
To cultivate the ability to conduct the own research based on the suggestions and values of the other fields through the own study of interdisciplinary research areas, and doctor's dissertation review and defense.

C) Ability to solve problems and to propose a new idea based on the expertise
To acquire the ability of technical problem solution through research seminars on electrical and electronic engineering and research project for doctoral dissertation.

D) Acquisition of leadership accepted in a worldwide activity
Students are expected to acquire the ability to play an active role as a leader through participation and presentation in international conferences, objective evaluations of the own research, international student exchange programs.

E) Ability of logical explanation in communication and documentation
Acquire the ability of logical explanation and communication to exchange the own view, idea, and opinion with researchers and/or engineers in various research fields through the own doctoral dissertation project and/or research courses.

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. Fulfill requirement in Table D1 below.
3. Pass the doctoral dissertation 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 Electrical and Electronic Engineering Completion Requirements

Course category		<Required courses> Required credits	<Electives> Minimum credits required	Minimum credits required	Associated learning goals	Comments
Liberal arts and basic science courses	Humanities and social science courses		2 credits	6 credits	B, D, E	
	Career development courses		4 credits		C, D, E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar S3 on Electrical and Electronic Engineering Seminar F3 on Electrical and Electronic Engineering Seminar S4 on Electrical and Electronic Engineering Seminar F4 on Electrical and Electronic Engineering Seminar S5 on Electrical and Electronic Engineering Seminar F5 on Electrical and Electronic Engineering A total of 12 credits, 2 credits each from the above courses.		18 credits	A, B, 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> the Graduate Major in Electrical and					

	Electronic Engineering 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 Electrical and Electronic Engineering

Course category		Course number			Course title	Credits	Competencies	Learning goals	Comments
Research seminars	**600 level**	EEE.Z691.R	◎		Seminar S3 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z692.R	◎		Seminar F3 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z693.R	◎		Seminar S4 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z694.R	◎		Seminar F4 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z695.R	◎		Seminar S5 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
		EEE.Z696.R	◎		Seminar F5 on Electrical and Electronic Engineering	0-0-2	1,3,4,5	A,B,C,D,E	
Research-related courses	**600 level**	EEE.R601.L			Training on Teaching Technique	0-1-0	1,3	D,E	
		EEE.R611.L		★	Doctor Course Colloquium	0-1-0	1,3	C,D,E	
		EEE.R622.L		★	International Presentations I	0-1-0	1,3	C,D,E	
		EEE.R623.L		★	International Presentations II	0-1-0	1,3	C,D,E	
		EEE.R631.L			Special Analysis on Electrical and Electronic Engineering	0-1-1	1,4,5	B,C,D	

		EEE.R641.L			Practical Research on Electrical and Electronic Engineering	0-1-1	1,4	B,C,D	
		EEE.R651.L		★	Study Abroad (Doctor Course) A	0-0-1	2,3,4,5	B,D,E	
		EEE.R652.L		★	Study Abroad (Doctor Course) B	0-0-2	2,3,4,5	B,D,E	
		EEE.R653.L		★	Study Abroad (Doctor Course) C	0-0-4	2,3,4,5	B,D,E	
		EEE.R654.L		★	Study Abroad (Doctor Course) D	0-0-6	2,3,4,5	B,D,E	
		EEE.R661.L			Internship (Doctor Course) A	0-0-1	2,3,4,5	B,C,D,E	
		EEE.R662.L			Internship (Doctor Course) B	0-0-2	2,3,4,5	B,C,D,E	
		EEE.R663.L			Internship (Doctor Course) C	0-0-4	2,3,4,5	B,C,D,E	
		EEE.R664.L			Internship (Doctor Course) D	0-0-6	2,3,4,5	B,C,D,E	
Major courses	**600 level**	EEE.G601.L		★	Teaching Skills in English for Doctoral Course Students	0-1-0	1,2,3,4,5	D,E	
		EEE.G611.L			Special Lecture I on Electrical and Electronic Engineering	1-0-0	1,2	A,B,C	
		EEE.G612.L			Special Lecture II on Electrical and Electronic Engineering	1-0-0	1,2	A,B,C	
		EEE.R665.L			Cooperative Education through Research Internships of Electrical and Electronic Engineering	0-0-4	1,3,4,5	B,C,D,E	
		EEE.R671.L			Research Presentations A	0-1-0	1,3,4,5	C,D,E	
		EEE.R672.L			Research Presentations B	0-1-0	1,3,4,5	C,D,E	
		EEE.C641.L		★	Advanced Topics in Digital VLSI Design	1-0-0	1,4	A,B	【School of Engineering】(XEG.S605)

Note：

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

•【 】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.D600.R): G (General Subjects), S (Wave, Photonics, and Communication), R (Off-Campus Projects), and 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 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 below.

However, it must be noted that credits attained from these courses can be counted towards the completion requirements of doctoral degree program, either for the Major Courses or for the Career Development Courses (i.e., not for both). Nevertheless, even in the cases from those mentioned above where attained credits pertaining to these courses are not considered as Career Development Courses, their associated GAs are always considered to have been acquired.

For Graduate Attributes, refer to the Guide to the Career Development Courses.
The Graduate Attributes of the Doctoral Degree Program are listed in Table A-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 the advanced leadership skills, entrepreneurial skills, knowledge and expertise, and by developing social responsibility necessary for materializing your designed career.

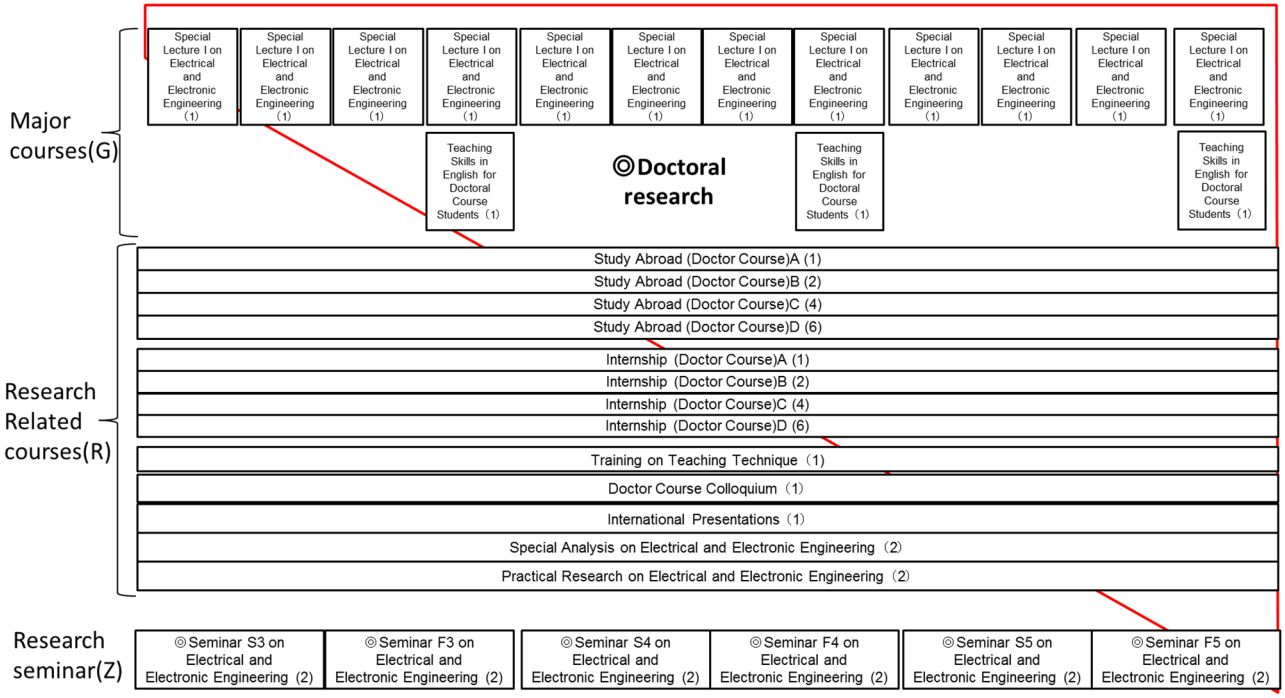
Table D3. Courses of the Graduate Major in Electrical and Electronic Engineering recognized as equivalent to Career Development Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	EEE.G601.L		★	Teaching Skills in English for Doctoral Course Students	0-1-0	GA1D	D,E	
	EEE.R611.L		★	Doctor Course Colloquium	0-1-0	GA1D	C,D,E	
	EEE.R601.L			Training on Teaching Technique	0-1-0	GA1D	D,E	
	EEE.R651.L		★	Study Abroad (Doctor Course) A	0-0-1	GA1D	B,D,E	
	EEE.R652.L		★	Study Abroad (Doctor Course) B	0-0-2	GA1D	B,D,E	

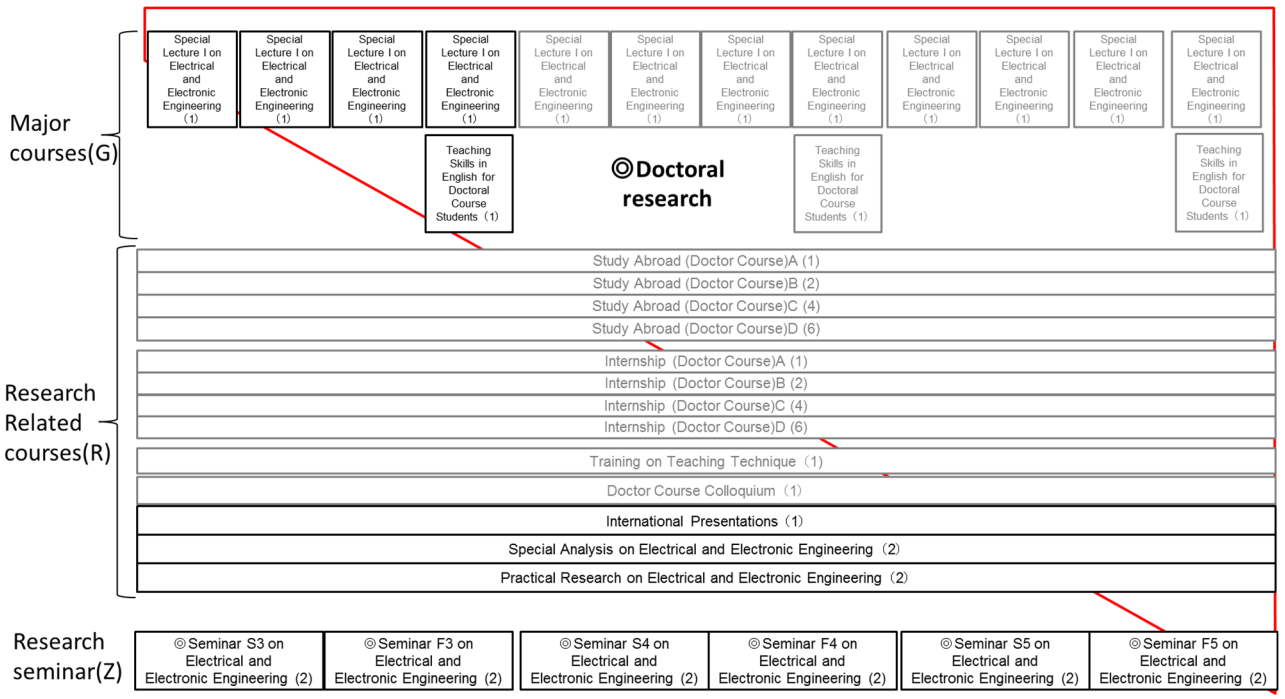
	EEE.R653.L		★	Study Abroad (Doctor Course) C	0-0-4	GA1D	B,D,E	
	EEE.R654.L		★	Study Abroad (Doctor Course) D	0-0-6	GA1D	B,D,E	
	EEE.R661.L			Internship (Doctor Course) A	0-0-1	GA1D	B,C,D,E	
	EEE.R662.L			Internship (Doctor Course) B	0-0-2	GA1D	B,C,D,E	
	EEE.R663.L			Internship (Doctor Course) C	0-0-4	GA1D	B,C,D,E	
	EEE.R664.L			Internship (Doctor Course) D	0-0-6	GA1D	B,C,D,E	
	EEE.R665.L			Cooperative Education through Research Internships of Electrical and Electronic Engineering	0-0-4	GA1D	B,C,D,E	
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, the Tokyo Tech Academy for Leadership (ToTAL) or WISE Programs 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

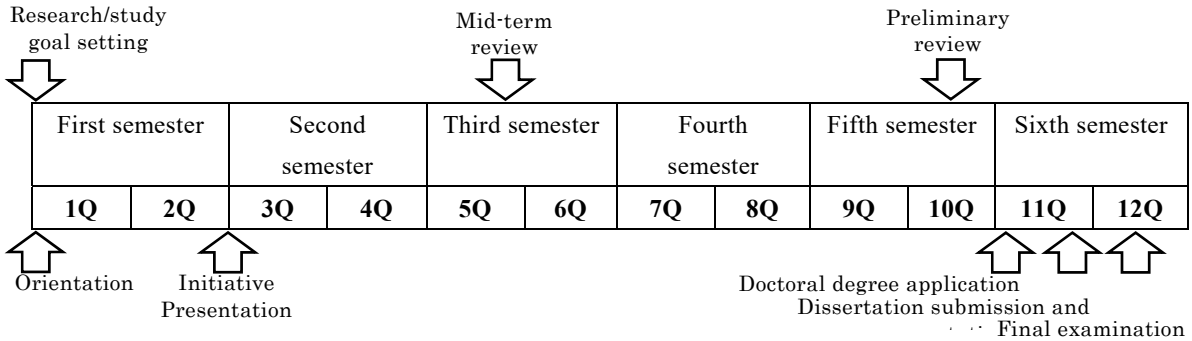


9. Example of a Standard Curriculum



10. Research Related to the Completion of Doctoral Theses

The doctoral degree program aims to cultivate the problem setting ability as well as the problem solving ability and to improve the communication and presentation skills, especially in English. These abilities and skills can be acquired through the processes of the study and/or research goal setting and the achievement evaluation. App.Fig.3 shows a standard flow in the doctoral degree program. As shown in the figure, initiative presentation should be made one semester after the enrollment. Each student has to take mid-term review one and half year prior to the completion, or during the third semester in the standard flow, and preliminary review a half year before, during the fifth semester. After the reviews, the student can be allowed to submit the doctoral degree application and his/her doctoral dissertation. The examination committee reviews the doctoral dissertation after the oral dissertation presentation. The doctoral degree can finally be recognized based on the results of the final examination on the doctoral dissertation.



App.Fig.3 A standard flow for the doctoral degree in the Graduate Major in Electrical and Electronic Engineering.

Dissertation review criteria

Each student has to submit his/her doctoral dissertation which must be written by him/herself. The dissertation should have novelty, creativity, and enough high academic value in the field of electrical and electronics engineering. The main part of the dissertation should already be issued in an academic journal with an international standard, or the dissertation must be recognized as an equivalent level. The doctoral dissertation should be written in English in principle.

Doctoral dissertation examination procedure

The examination committee consists of five or more faculty members and an external examiner from another university, research institute, or company in principle. The committee reviews the dissertation submitted from the doctoral candidate who has passed the mid-term and preliminary reviews. After the oral dissertation presentation, the committee examines and evaluates the dissertation as the final review. The committee confirms the comprehensive ability in the corresponding field and English communication and presentation skills in the final examination.