

Graduate Major in Information and Communications Engineering

【Master's Degree Program】

1. Outline

We aim to cultivate researchers, engineers and candidates of executives globally playing active part in various field such as industries; such individuals have top class competence in theoretical comprehension and practical application development in broad expertise on fundamental and applied technologies, which support human centered and sustainable advanced information and communications society from both hardware and software aspects and include communication and network, signal processing, VLSI (very large scale integrated circuits), computer, security, media information processing, bio information processing, sensory information processing and intelligent information processing.

2. Competencies Developed

After completing the program, students will acquire the following competencies:

- Expert abilities required for research and development in information and communications engineering fields.
- Skills to learn expert abilities in related fields and to apply them to practical problem solving.
- Skills for new problem solving and creative proposal applying expertise in a relation with the society.
- Skills to comprehend and systematize research and development trends with international perspective.
- Skills to engage in businesses relating to information and communication fields.
- Skills to explain and document about information on science and technology. Skills to develop arguments on them.
- Skills for engaging research and development with strong sense of ethics.

3. Learning Goals

To obtain the competencies described in the curriculum provided in this course, the goals of learning are as follows:

A) Mastery of fundamental expertise in information and communication engineering

Look back upon fundamental expertise fields studied in undergraduate and establish fundamental knowledges on the fields.

B) Mastery of developed expertise in information and communication engineering

Establish cutting edge knowledges from international perspective systematically.

C) Mastery of liberal arts and career literacy

Study humanities, social sciences, interdisciplinary courses and latest trends in industries to acquire literacy as an engineer or researcher in information and communication engineering and wide field of view and ethics for leaders in industries.

D) Mastery of expertise in different fields

Acquire cross sectoral and interdisciplinary knowledge in broad science and engineering to widen expertise and get flexibility for different fields.

E) Mastery of creative proposal and problem solving

Acquire creative proposal skills and pragmatic problem solving skills by working on individual research theme for master thesis proactively. Acquire skills to develop logical discussion, through the master's thesis research guidance by the supervisor.

F) Mastery of skills on design and communication

Acquire skills on problem setting, specification development, project management and communications, through making personal portfolio, research plan presentation and intermediate review.

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 Information and Communications 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		<ul style="list-style-type: none"> •2 credits from 400-level •1 credit from 500-level 	5 credits	C	
	Career development courses		2 credits		C	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar in Information and Communications Engineering S1 Seminar in Information and Communications Engineering F1 Seminar in Information and Communications Engineering S2 Seminar in Information and Communications Engineering F2 A total of 8 credits, 2 credits each from the above courses.		22 credits from the Graduate Major in Information and Communications Engineering standard curriculum	E	
	Research-related courses					
	Major courses		2 credits from group A and 2 credits from group B		A	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Information and Communications			2 credits	D	

	Engineering standard curriculum					
Total required credits		A minimum of 30 credits including those attained according to the above conditions				
Note		<ul style="list-style-type: none"> • Group A consists of Communications and Computer Engineering I and Communications and Computer Engineering II. Group B consists of Human-Centric Information Systems I and Human-Centric Information Systems II • 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 Information and Communications Engineering

Course category		Course number	Course title		Credits	Competencies	Learning goals	Comments	
Research seminars	400 level	ICT.Z491.R	◎		Seminar in Information and Communications Engineering S1	0-2-0	1,2,3,4,5	E	
		ICT.Z492.R	◎		Seminar in Information and Communications Engineering F1	0-2-0	1,2,3,4,5	E	
	500 level	ICT.Z591.R	◎		Seminar in Information and Communications Engineering S2	0-2-0	1,2,3,4,5	E	
		ICT.Z592.R	◎		Seminar in Information and Communications Engineering F2	0-2-0	1,2,3,4,5	E	
Major courses	400 level	ICT.I423.L		□	Mixed Signal Circuits	2-0-0	3,5	B	【Electrical and Electronic Engineering】 (EEE.C411)
		ICT.A402.A	A	○	Communications and Computer Engineering I	2-0-0	1	A	
		ICT.A406.B	B	○	Human-Centric Information Systems I	2-0-0	3,5	A	
		ICT.A413.A	A	○	Communications and Computer Engineering II	2-0-0	3	A	
		ICT.A418.B	B	○	Human-Centric Information Systems II	2-0-0	3,4,5	A	

		ICT.C401.L		J	Modern Cryptography	2-0-0	3	B	
		ICT.C412.L		J	Advanced Communication System Engineering	2-0-0	3,5	B	
		ICT.C417.L		J	Data Communication System	2-0-0	3,4	B	
		ICT.H404.L		J	Medical Informatics	1-0-0	3,5	B	
		ICT.H409.L		E	Optics in Information Processing	1-0-0	3	B	
		ICT.H410.L			Computational Linguistics	2-0-0	3	B	
		ICT.H411.L		E	Basic Sensation Informatics	1-0-0	3,5	B	
		ICT.H416.L		O	Statistical Theories for Brain and Parallel Computing	2-0-0	3,4,5	B	
		ICT.H420.L		O	Large Scale Computing Systems	1-0-0	3	B	
		ICT.H421.L		E	Medical Imaging Systems	1-0-0	3	B	
		ICT.H422.L		O	Computational Brain	1-0-0	3	B	
		ICT.I408.L		J	Analog Integrated Circuits	2-0-0	3,4,5	B	
		ICT.I415.L			VLSI System Design	2-0-0	3,4,5	B	
		ICT.I419.L		J	VLSI Layout Design	2-0-0	3	B	
		ICT.J405.L		J	Strategic ICT Policy Planning	2-0-0	1,3,4	B	
		ICT.S403.L		J	Multidimensional Information Processing	2-0-0	3,5	B	
		ICT.S407.L			Wireless Signal Processing	2-0-0	3	B	
		ICT.S414.L			Advanced Signal Processing (ICT)	2-0-0	3,4,5	B	
	500 level	ICT.H505.L		J	Exercise in Human-Centric Information Processing	0-2-0	2,3,4,5	B	
		ICT.A512.L		E	Advanced Information and Communication Theory	2-0-0	3,5	B	
		ICT.A515.L		J	Theory of Parallel and VLSI Computation	2-0-0	3	B	
		ICT.C506.L		J	Advanced Information and Communication Network	2-0-0	2,3,4	B	

		ICT.C511.L		J	Advanced Topics in Mobile Communications	2-0-0	3	B	
		ICT.H502.L		J	Media Quality	1-0-0	3,5	B	
		ICT.H503.L		E	Speech Information Technology	2-0-0	3,5	B	
		ICT.H504.L		O	Medical Image Processing	2-0-0	3,5	B	
		ICT.H507.L			Virtual Reality and Interaction	2-0-0	1,3,4	B	
		ICT.H508.L		O	Language Engineering	2-0-0	2,3	B	
		ICT.H509.L		E	Measurement of Brain Function	1-0-0	3	B	
		ICT.H513.L		J	IT Society and Information Security	2-0-0	3,5	B	
		ICT.H514.L		O	Mechanisms of Visual Perception	1-0-0	3,5	B	
		ICT.H517.L			Advanced Measurement of Sensory Information	2-0-0	3,5	B	
		ICT.I501.L		J	Engineering of System LSI Design (System Design)	2-0-0	3,5	B	
		ICT.I516.L		J	Engineering of System LSI Design (Embedded Software Design)	2-0-0	3,4,5	B	
		ICT.J510.L		J	Exercises on Strategic ICT Policy Planning	0-2-0	2,3,5	B	
		ICT.O518.L			Information and Communications Engineering Course Off-Campus Project (Master Course)	0-2-0	1,2,3,4,5	C	

Note :

- ◎ : Required course, ○ : Restricted elective, O : in English in odd academic years, E : in English in even academic years, J : in Japanese
- □ : Course recognized as equivalent to that of the Academy for Co-creative Education of Environment and Energy Science, Leading Graduate School (ACEEES).
- Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = Practical and/or problem-solving skills
- 【 】 Course offered by another graduate major
- The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ABC.D400.R): A (fundamental courses), C/S (communication/network/security courses), H (human centric system courses), I (Integrated Circuit/Computational machinery courses), J/O (carrier courses), 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

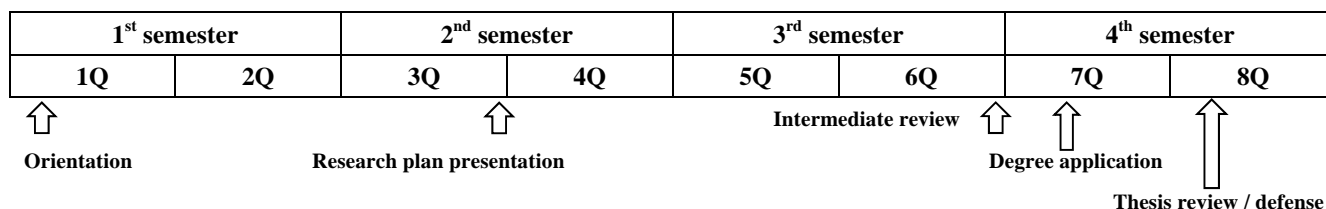
Table M3. Courses of the Graduate Major in Information and Communications Engineering recognized as equivalent to Career Development Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	ICT.J405.L		J	Strategic ICT Policy Planning	2-0-0	C0M C1M	B	
	ICT.J510.L		J	Exercise on Strategic ICT Policy Planning	0-2-0	C0M C1M	B	
	ICT.O518.L			Information and Communications Engineering Course Off-Campus Project (Master Course)	0-2-0	C1M	C	
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

Important objectives in the master's thesis research are to experience a process of research and to develop skills on problem setting, problem solving and communication.

Though a standard flow is shown below, the schedule of events such as the reviews can be varied on individual status such as research progress and enough consultation with the supervisor is required to determine details such as research schedule.



- Research plan presentation and intermediate review

From career development points of view, to be conscious of research background and purpose clearly, a research plan presentation and intermediate review are placed by around after the 3Q's and 6Q's end respectively. In the research plan presentation, individuals organize and make a presentation, which consists of research plan and preliminary research results. The question-and-answer session deepens the understanding on research background and confirms validity of problem setting of the research plan to develop skills on problem setting and communication. In the intermediate review, individuals organize and make a presentation, which contains research progress and problem solving plan after the review. The jury evaluates whether the presentation has or will have an original study including new knowledge with academic value or useful contribution in information and communications engineering, as the results of the research.

【Doctoral Degree Program】

1. Outline

We aim to cultivate researchers, engineers, candidates of executives globally playing active part in various field such as industries, and leaders of leading and pioneering frontier science and technology for achieving a plentiful global society; such individuals have top class competence in theoretical comprehension and practical application development in broad expertise on fundamental and applied technologies, which support human centered and sustainable advanced information and communications society from both hardware and software aspects and include communication and network, signal processing, VLSI (very large scale integrated circuits), computer, security, media information processing, bio information processing, sensory information processing and intelligent information processing.

2. Competencies Developed

After completing the program, students will acquire the following competencies with higher level than master's program:

- Expert abilities required for research and development in information and communications engineering fields.
- Skills to learn expert abilities in related fields and explore new field, as well as to apply them to practical problem solving.
- Skills for new problem solving and creative proposal applying expertise in a relation with the society.
- Skills to comprehend and systematize research and development trends with global field of view.
- Skills to engage in highly professional businesses relating to information and communication fields.
- Skills to develop new knowledge based on previous works according to original research which relating to information and communication fields and independently complete work as a researcher.
- Skills to explain and document about information on science and technology, in addition to leading a research and development team as a team leader.
- Skills for engaging research and development with strong sense of ethics.

3. Learning Goals

To obtain the competencies described in the competencies developed provided in this course, learn along the curriculum that has the following characteristics:

- A) Mastery of highly specialized expertise in information and communication engineering
Look back upon expertise studied in master, and master higher specialized expertise needed for doctoral research.
- B) Mastery of problem setting skills and advanced problem solving skills
Through the doctoral research guidance, set and challenge the new research issue to master problem setting skills and advanced problem solving skills.
- C) Mastery of wide and deep knowledge and ethics
Through research activities such as seminars, establish the cutting edge knowledges from international perspective systematically in information and communication engineering to master wide and deep knowledge and ethics.
- D) Mastery of skills for original research and technological development
Through research presentation in international conferences and paper publishing in academic journals as a researcher, acquire skills to contribute new knowledges to conversational academic standards at the international level.
- E) Mastery of skills to manage the process of research

Through intermediate review and achievement review in addition to regular presentations in research activities such as seminars, master the skills to manage research processes.

F) Mastery of internationally accepted leadership

Through international conferences and internship, actively discuss with researchers and engineers of the front-line in overseas including people from different research fields. Then, establish skills to develop advanced discussions and to organize and aggregate different ideas and advices as a leader.

G) Mastery of advanced perspective on trends in the industries in Japan and overseas

Through lectures and seminars, learn about latest trends in the information and communication industry, to master advanced perspective and ethics required for the leader of the industry.

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 requirements 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 Information and Communications 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	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 Information and Communications S3 Research Seminar in Information and Communications F3 Research Seminar in Information and Communications S4 Research Seminar in Information and Communications F4 Research Seminar in Information and Communications S5 Research Seminar in Information and Communications F5 A total of 12 credits, 2 credits each from the above courses.		12 credits from the Graduate Major in Information and Communication s Engineering standard curriculum	C,D,E	
	Research-related courses				D,E	
	Major courses				A,B,C,D,E	
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.
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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 Information and Communications Engineering

Course category	Course number	Course title	Credits	Competencies	Learning goals	Comments
Research seminars	600 level	ICT.Z691.R ◎ Seminar in Information and Communications Engineering S3	0-2-0	1,2,3,4,5	B,C,E,G	
		ICT.Z692.R ◎ Seminar in Information and Communications Engineering F3	0-2-0	1,2,3,4,5	B,C,E,G	
		ICT.Z693.R ◎ Seminar in Information and Communications Engineering S4	0-2-0	1,2,3,4,5	B,C,E,G	
		ICT.Z694.R ◎ Seminar in Information and Communications Engineering F4	0-2-0	1,2,3,4,5	B,C,E,G	
		ICT.Z695.R ◎ Seminar in Information and Communications Engineering S5	0-2-0	1,2,3,4,5	B,C,E,G	
		ICT.Z696.R ◎ Seminar in Information and Communications Engineering F5	0-2-0	1,2,3,4,5	B,C,E,G	
Major courses	600 level	ICT.C601.L Quantum Information Processing	2-0-0	3,4,5	A	
		ICT.O602.L Special Experiments of Information and Communications Engineering I	0-0-2	2,3,5	E	
		ICT.O603.L Special Experiments of Information and Communications Engineering II	0-0-2	2,3,5	E	
		ICT.O604.L Special Experiments of Information and Communications Engineering III	0-0-2	2,3,5	E	
		ICT.O605.L Presentation Exercises of Information and Communications Engineering Course I	0-1-0	2,3	D,F	
		ICT.O606.L Presentation Exercises of Information and Communications Engineering Course II	0-1-0	2,3	D,F	
		ICT.O608.L Information and Communications Engineering Course Long-Term Off-Campus Project (Doctor Course)	0-4-0	1,2,3,4,5	F,G	

Note :

- ◎ : Required course, ○ : Restricted elective, O : in English in odd academic years, E : in English in even academic years, J : in Japanese
- 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 (fundamental courses), C/S (communication/network/security courses), H (human centric system courses), I (Integrated Circuit/Computational machinery courses), J/O (carrier courses), Z (Research seminars)

6. IGP Courses That Can Be Counted as Humanities and Social Science Courses

None

7. IGP Courses That Can Be Counted as Career Development Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least 4 credits in Career Development Courses, and should satisfy all of the Graduate Attributes (GA) specified in Table A-1 or A-2 of the "Career Development Courses" (Liberal Arts and Basic Science Courses) in the Guide to Graduate Education and International Graduate Program. Students will be evaluated in regards to GA achievements at the time of their degree completion. As to the courses with more than one GA, the number of GA stipulated for the courses is considered to be acquired regardless of the credits received for the courses.

Major Courses that enable students to acquire GA and that are recognized as equivalent to Career Development Courses are listed in Tables D3-1 and D3-2 below.

However, it must be noted that credits attained from these courses cannot be counted more than once as Major Courses or Career Development Courses towards the completion requirements for the doctoral degree program.

For Graduate Attributes, refer to the Guide to the Career Development Courses.

The Graduate Attributes of the Academic Leader Program (ALP) are listed in Table A-1 as follows:

- A0D: You will be able to precisely draw your own career plan and self-train yourself to acquire the skills required for attaining your goals in the academic field
- A1D: You will be able to ascertain the true nature of phenomena, master the secret of learning, and lead the pioneering of a new academic discipline or research area
- A2D: You will be able to understand the position of academia in society, and adequately explain the academic progress to members of society, which is the stakeholder
- A3D: You will be able to nurture junior students in educational institutions, inculcating in them an interest in academics and enabling them to later join in the pioneering of new academic disciplines or research areas

The Graduate Attributes of the Productive Leader Program (PLP) are listed in Table A-2 as follows:

- P0D: You will be able to precisely draw your own career plan and self-train yourself to acquire the skills required for attaining your goals in the industry, etc.
- P1D: You will be able to precisely grasp the needs of society and detect its problems, and lead the future developments in science and technology
- P2D: While leading teams consisting of members with varied specialties and value systems, you will be able to create products and enterprises that bring forth new values in the society
- P3D: Through the project, you will be able to nurture junior students, enabling them to later join in the development of next generation society and industry

Table D3-1. Courses of the Graduate Major in Information and Communications Engineering 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	ICT.O608.L			Information and Communications Engineering Course Long-Term Off-Campus Project (Doctor Course)	0-4-0	A2D, A3D	F,G	
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								

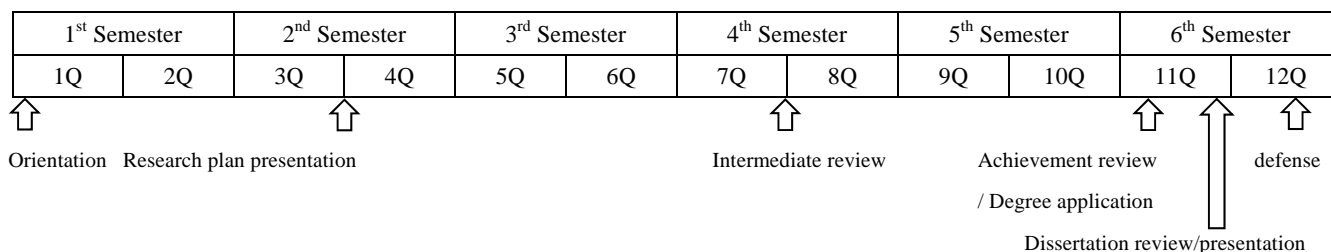
Table D3-2. Courses of the Graduate Major in Information and Communications Engineering recognized as equivalent to Career Development Courses in the Productive Leader Program (PLP)

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	ICT.O608.L			Information and Communications Engineering Course Long-Term Off-Campus Project (Doctor Course)	0-4-0	P2D, P3D	F,G	
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 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 Dissertation

Doctoral research requires problem setting skills in addition to problem solving skills. Though a standard flow is shown below, the schedule of events such as presentations and reviews can be varied on individual status such as research progress and enough consultation with the supervisor is required to determine details such as research schedule.



- Criteria for doctoral dissertation evaluation

Doctoral dissertation must be an original self-written dissertation with novelty, originality and enough academic value and the main parts must be published in publications such as international level academic journals.

- Doctoral dissertation defense procedure

The jury committee must be equal or more than five members. Deployments of external jury committee members from other universities, research institutes and enterprises etc. is encouraged.

It is required to pass an intermediate review (in 7Q in standard) and an achievement review (in 11Q in standard) before dissertation review. To take an achievement review, an intermediate review must be passed. After the dissertation submission, the dissertation presentation (in 11Q in standard) is held before the defense (in 12Q in standard).