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. A total of 30 credits or more acquired from 400- and 500-level courses.
2. Meet the completion requirements indicated in Table M1 below.
3. Pass the master's thesis review and defense.

Table M1 shows that the course classification for this major, and the number of credits needed to obtain a Master’s Degree. The required number of credits is indicated by course category and course group. The column on the right shows that the learning goals related to the courses. Students should have a good understanding of the relationship between the course and the learning goals when signing up for the course.

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		•2 credits from 400-level •1 credit from 500-level	5 credits	C	
	Career development courses		2 credits		C	
	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 Engineering standard curriculum			2 credits	D	
Total required credits		A minimum of 30 credits in addition to meeting the above conditions				

Note	**・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 Humanities and Social Science Courses of the corresponding course level.** **・As for Liberal Arts and Basic Science Courses, please refer to the relevant pages.**

5. IGP Courses

Table M2 shows that courses from the specialized courses for the Master's Degree curriculum of this major.
A course with other major's name written in the comments column with 【】shows that the specialized course is offered under another graduate major and counted as a specialized course of standard courses of this major when completed.

Table M2. Core Courses of the Graduate Major in Information and Communications Engineering

Course category		**Course number**	**Course**			**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	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	2,3,5	B	
		ICT.I516.L		J	Engineering of System LSI Design (Embedded Software Design)	2-0-0	2,3,5	B	
		ICT.J510.L		J	Exercises on Strategic ICT Policy Planning	0-2-0	1,2,5	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

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills;
5 = Practical and/or problem-solving skills

・【　】Course offered under 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 Recognized as Humanities and Social Science Courses

None

7. IGP Courses That Can be Recognized as Career Development Courses

As a general rule, students who would like their Career Development Courses to contribute to completion requirements of their master's degree program need to satisfy all of the specified Graduate Attributes ("GA"), including the attainment of at least two course credits, listed in Table MA-1 of the "Guide to Graduate Education and International Graduate Program (Liberal Arts and Basic Science Courses) - Career Development Courses". The status of the GA will be evaluated at the time of degree completion.

In addition to Career Development Courses, there are Major Courses that can also be recognized as such — shown below in Table M3 — which may go toward fulfilling the GA requirements.

However, note that when the corresponding Major Courses are recognized and accredited as Career Development Courses, their credits cannot be counted a second time (as Major Courses) towards degree completion requirements.

Table M4 shows that courses offered in this major that can be counted as Career Development Courses. Keep in mind that if a relevant course is counted as a Career Development Course, it will not be able to be included in the course's original course category for completion requirements

Table M3. Courses of the Graduate Major in Information and Communications Engineering that can be recognized as Career Development Courses

Course category	**Course number**	**Course**			**Credits**	**GA***	**Learning goals**	**Comments**
can be recognized 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	

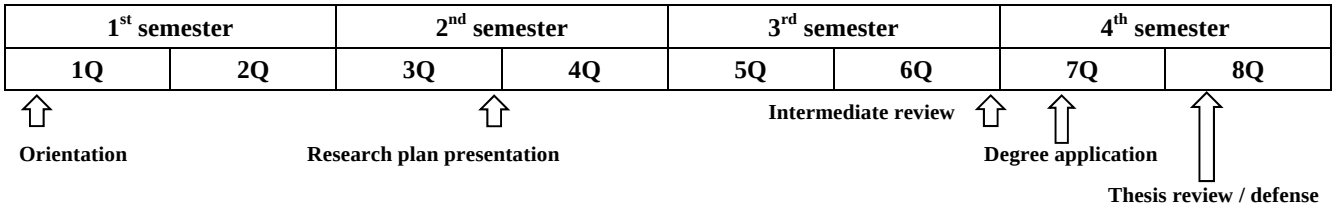
To satisfy the Career Development Courses requirement, credits may be acquired from courses listed above as well as from those listed under Career Development Courses (see the Liberal Arts and Basic Science Courses Guide).

＊GA: Graduate Attribute

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. A total of 24 credits or more acquired from 600-level courses.
2. Meet the completion requirements indicated in Table D1 below.
3. Pass the doctoral dissertation review and defense.

Table D1 shows that the course classification for this major, and the number of credits needed to complete the Doctoral Degree Program. The required number of credits is indicated by course category and course group. The column on the right shows that the learning goals related to the courses. Students should have a good understanding of the relationship between the course and the learning goals when signing up for the course.

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	
	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 Communications 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 in addition to meeting the above conditions				
Note		・Japanese Language and Culture Courses offered to International Students can be recognized as Humanities and Social Science Courses of the corresponding course level. ・As for Liberal Arts and Basic Science Courses, please refer to the relevant pages.				

5. IGP Courses

Table D2 shows that courses from the specialized courses for the Doctoral Program's curriculum of this major. A course with other major's name written in the comments column with 【】shows that the specialized course is offered under another graduate major and counted as a specialized course of standard courses of this major when completed.

Table D2. Core Courses of the Graduate Major in Information and Communications Engineering

Course category		Course number	Course			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 Recognized as Humanities and Social Science Courses

None

7. IGP Courses That Can be Recognized as Career Development Courses

As a general rule, students who would like their Career Development Courses to contribute to completion requirements of their doctoral degree program need to satisfy all of the specified Graduate Attributes ("GA"), including the attainment of at least four course credits, listed in Table A-1 or A-2 of the "Guide to Graduate Education and International Graduate Program (Liberal Arts and Basic Science Courses) - Career Development Courses". The status of the GA will be evaluated at the time of degree completion.

In addition to Career Development Courses, there are Major Courses that can also be recognized as such — shown below in Table D3-1 and D3-2 — which may go toward fulfilling the GA requirements.

However, note that when the corresponding Major Courses are recognized and accredited as Career Development Courses, their credits cannot be counted a second time (as Major Courses) towards degree completion requirements.

Table D3-1. Courses of the Graduate Major in Information and Communications Engineering that can be recognized as Career Development Courses in the Academic Leader Program (ALP)

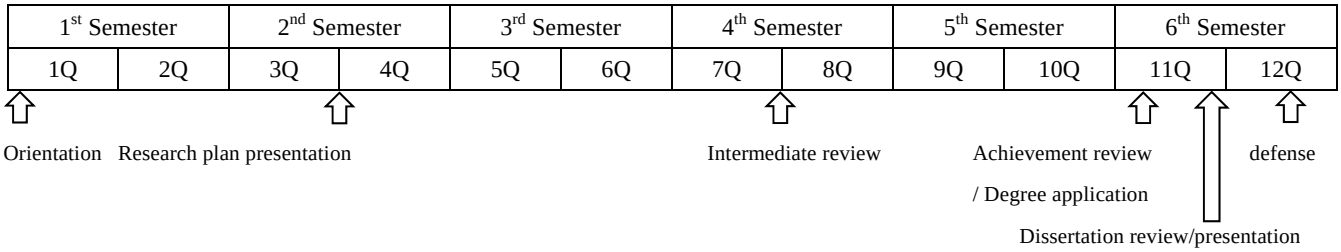
Course category	Course number	Course			Credits	GA*	Learning goals	Comments
can be recognized as Career Development Courses	ICT.O608.L			Information and Communications Engineering Course Long-Term Off-Campus Project (Doctor Course)	0-4-0	A2D, A3D	F,G	
To satisfy the Career Development Courses requirement, credits may be acquired from courses listed above as well as from those listed under Career Development Courses (see the Liberal Arts and Basic Science Courses Guide). **＊GA: Graduate Attribute**								

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

Course category	Course number	Course			Credits	GA*	Learning goals	Comments
can be recognized 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	
To satisfy the Career Development Courses requirement, credits may be acquired from courses listed above as well as from those listed under Career Development Courses (see the Liberal Arts and Basic Science Courses Guide). **＊GA: Graduate Attribute**								

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).