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Graduate School / Faculty of

Information Science and Electrical Engineering

ISEE Kyushu University



Information Science and Electrical Engineering
Kyushu University



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Information Science and Electrical Engineering for a New Era

In April 2021, Kyushu University's Faculty of Information Science and Electrical Engineering transitioned to a new organisational structure. Facing a new, rapidly changing era, the field of Information Systems aims to develop expert personnel in the fields of Artificial Intelligence, Mathematics, and Data Science, while the field of Electrical Engineering aims to develop professionals who can contribute to the development of the field of information science and the construction of social infrastructure from the point of view of hardware. To this end, we established a new Department of Information Science and Engineering by integrating the Department of Informatics and the Department of Advanced Information Technology. This will facilitate the development of professionals who combine the power of theory and implementation. Three master's courses were also established in the new Department of Information Science and Engineering: Information Architecture and Security course, Data Science course, and AI/Robotics Course. The existing master's courses were also reorganised in the Department of Electronic Engineering into an Information Device Systems course and an Energy Device Systems course. The names of each of these five courses correspond to the ways in which students use the course content that they have learned in society. In other words, students are taught both theory and fundamentals of specialist domains as represented by the names of the departments and their use in society as well as the name of the course. For those who are considering enrolling at our department or hiring a graduate student, we are proud to state that it has become easier to understand the form of education received by the students and the settings in which graduates can play an active role.

The Graduate School and Faculty of Information Science and Electrical Engineering is a rare undergraduate teaching and research organisation at a major university in Japan that integrates the fields of information science and electrical engineering. In the future, technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI) will be developed, and befitting the name 'Society 5.0', these technologies will be used in all aspects of society, such as industry, agriculture, commerce, transportation, education, medical treatment, disaster prevention, and daily living, to realise a sustainable and rich society. Skills that support these technologies such as sensing, communication, data analysis, decision-making, and control will be promoted. Moreover, we will also promote comprehensive education and research into the theories that underlie these skills as well as the electronic devices and energy supply that underpin the implementation of these skills. Considering that they will be actively leveraged in the society of the future, the fields of Informatics and Electronic and Electrical Engineering are not mutually exclusive but are closely connected. We refer to this as 'Information Science and Electrical Engineering'.

We will promote research on Information Science and Electrical Engineering for the new era; develop professionals; and contribute to the construction of a safe, secure, and more human society. This will be accomplished through the Faculty of Information Science and Electrical Engineering, a newly restructured graduate school educational organisation, and the Graduate School of Information Science and Electrical Engineering, a graduate school research organisation, and by conducting research and education in related fields established within and outside the institute in close cooperation with the Center for Optical and Quantum Process Research and Development, the Research Institute of Advanced Electrical Propulsion Aircraft, the Education and Research Center for Mathematics and Data Science, the Research and Development Center for Five Senses, the Center for Japan-Egypt Cooperation in Science and Technology, the Center of Plasma-Nano Interface Engineering (CPNE), the Center for Research and Development in Information Infrastructure, the Research Institute of Superconductor Science and Systems, and the System LSI Research Center.

Kyushu University Graduate School.

Distinguished Professor
Dean of Faculty and Graduate School of
Information Science and Electrical Engineering

Junichi Murata, Dr. Eng.



Overview

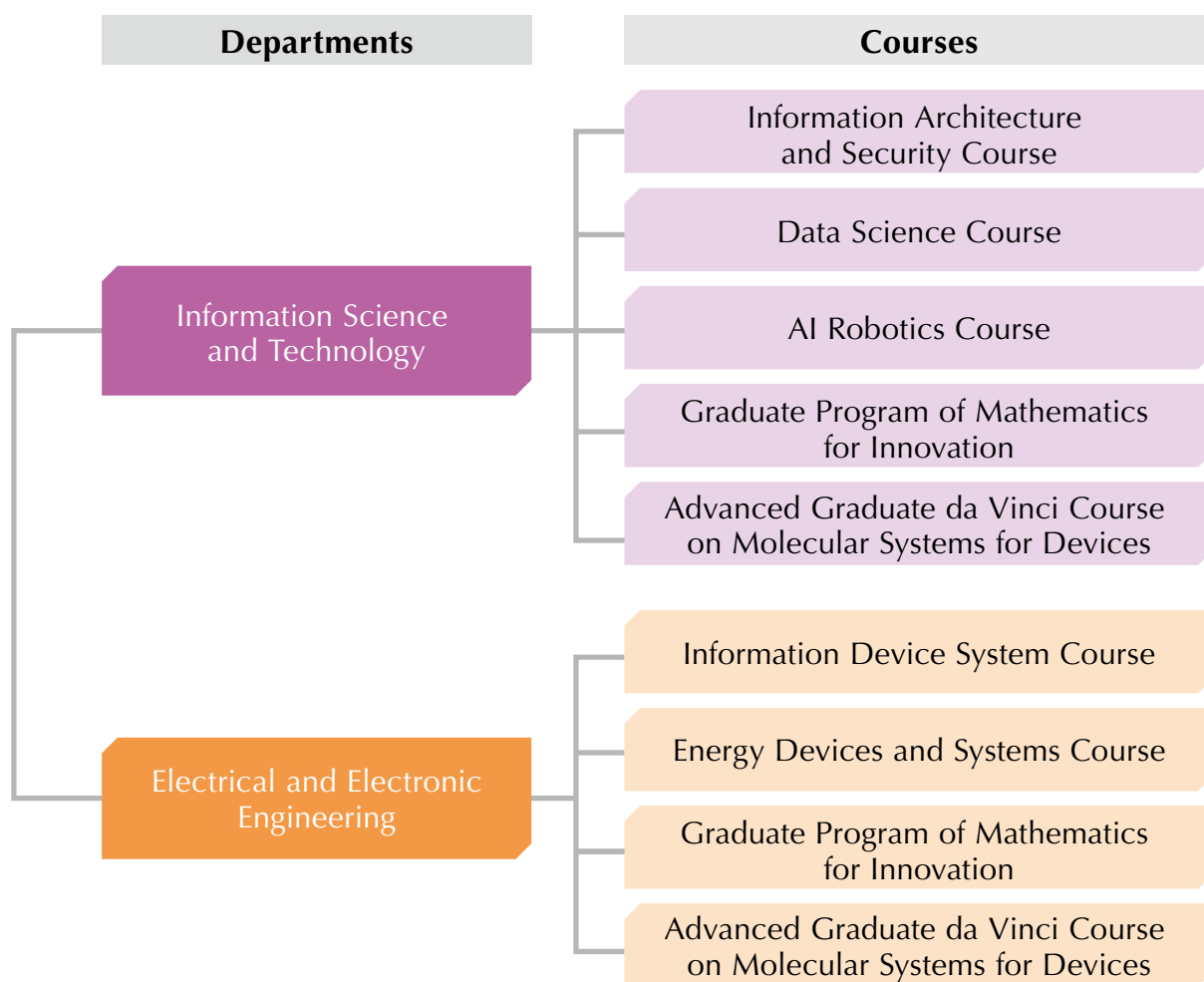
The Aims of the Faculty of Information Science and Electrical Engineering

Given the sophistication and widespread use of information processing, and information and communication technologies, information science is becoming an extremely important discipline as a fundamental science that underpins scientific methodologies such as mathematics and physics. In addition, the insights derived from information science deeply penetrate not only all academic fields, from the humanities to science, but also our day-to-day social lives. They also have a great impact on society, culture, and the economy. Electrical engineering has a long history and a large industrial reach. It has not only continued to contribute to the development of the information industry as a sort of mother discipline but also created an extremely high-functioning, complex, and large-scale electro-electrical system, which is expected to continue to develop in close cooperation with information science. In light of these social circumstances, the Faculty of Information Science and Electrical Engineering will cultivate in the next generation of researchers and technicians, a wide range of intellectual interests, internationality, ethics, and advanced expertise, as well as R&D capabilities in researchers' respective fields.

The Structure and Capacity of the Faculty of Information Science and Electrical Engineering

The faculty comprises the Department of Information Science and Engineering, which has a systematic understanding of the sophisticated fundamental knowledge of information mathematics, artificial intelligence, data science software, and computational engineering, and the Department of Electronic Engineering, which has a systematic understanding of the sophisticated fundamental knowledge of electrical, electronic, and communication engineering. These two departments collaborate and offer a diverse educational programme, ranging from basic to applied Information Science and Electrical Engineering, as part of a new discipline. The two-department system allows for flexible responses to future changes in social needs and educational content. In addition, by structuring departments on the basis of the needs of the fields being discussed, the content to be completed by students is clarified. More specifically, the Department of Information Science and Engineering has established an Information Architecture and Security course, a Data Science course, and an AI/Robotics course, and the Department of Electronic Engineering has launched an Information Device and Systems course and an Energy Device and Systems course. Through cooperation between these two departments, researchers will be trained to provide them with the ability to open up and create new fields in the domain of Information Science and Electrical Engineering as well as become advanced professionals with a broad perspective. In addition, we strive to develop technicians and researchers who can propose and solve problems and are rich in internationality, creativity, and autonomy.

Departments and Their Quota of Students



Quota of Students

Departments	Doctoral Course	Master's Course
Information Science and Technology	29	105
Electrical and Electronic Engineering	65	16
Total	170	45

Department of Information Science and Technology

The Philosophy and Admissions Policy of the Department

In the Department of Information Science and Engineering, we systematically teach about and conduct research in information science and engineering, a new academic discipline that investigates the nature of various 'information'-related phenomena involving nature, society, and humans. The purpose of this research is to cultivate professionals who are capable of developing advanced technologies for a highly informatic society and who may provide new insights into information science and engineering from an international perspective.

To realise this philosophy, we have established courses in Mathematical Information, Intellectual Science, Computational Science, Advanced Information System Engineering, Advanced Software Engineering, and Real-world Robotics. In addition, regarding master's courses, three educational programmes are offered which differ based on the expertise being acquired from them:

(1) Information Architecture and Security Course

Students will study and develop advanced technology related to information architecture and security that will form the basis of an advanced informatics society. They will be developed into professionals who possess an international perspective to uncover new horizons for information science and electrical engineering.

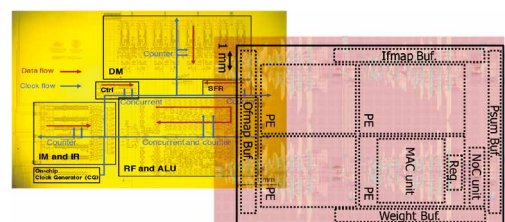
(2) Data Science Course

Researchers and data scientists will be nurtured to become professionals responsible for maintaining and advancing the foundations of advanced data science.

(3) AI Robotics Course

New fields in the domains of AI, IoT, and robotics will be uncovered to realise our Cyber Physical System. The course will cultivate advanced researchers and engineers who will be responsible for developing these fields.

In the Department of Information Science and Engineering, students who have a deep understanding of the philosophy of this department and who can learn proactively on their own in accordance with the philosophy are sought. More specifically, the ones who engage in research into basic theories while constantly conscious of practice, who can conduct applied research based on basic theory, who dare to challenge themselves in new fields, who aim to acquire high-level practical skills in Information Communication Technologies (ICTs), and who aim to acquire advanced technologies in real-world information processing, such as robotics and multimedia processing, and information- and communication-processing mechanisms. We expect students and researchers who enrol with us to be highly motivated. In addition, we actively accept students and working people who are willing to acquire advanced specialised knowledge in information science and engineering in the doctoral programme, and we strive to train engineers and researchers who will support the future.



Department of Electrical and Electronic Engineering

The Philosophy and Admissions Policy of the Department

In addition to its expertise in systematically understanding the sophisticated basic knowledge of electrical, electronic, and communication engineering and its expertise in using data science and other information technologies, the Department of Electronic Engineering and Communication Sciences has the ability to create (to think things through), plan (to shape ideas), and persuade (convince people to consider). In the field of information and communication as well as that of social infrastructure systems centred around energy, the department will train new professionals who will work to solve complex issues with the creativity of advanced expertise, lead new R&D, and adjust spontaneously in response to changes in society, such as Society 5.0.

We provide education on both knowledge and theory related to electric engineering and how to realise and use it in society. Since the master's programmes are courses that correspond to completing a six-year integrated programme, we will establish two courses corresponding to the fields that realise and use electronic and electrical engineering and provide education on knowledge or theory and realisation or application in each field, to increase expertise. The two courses look at fields that are and will continue to be, very important in society. They are the Information Device and System course for Information Hardware, and the Energy Device and System course for Social Infrastructure.

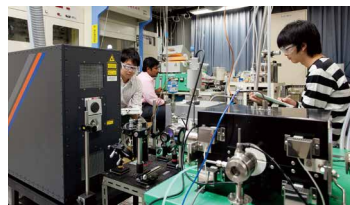
1 Information Device System Course

In the field of social infrastructure systems centred on information and communication, students will be nurtured to become professional who can work to resolve complex issues with the advanced expertise of electrical and electronic engineering, and can lead new R&D and adjust spontaneously in response to social changes, such as Society 5.0.

2 Energy Devices and Systems Course

In the field of social infrastructure systems centred on energy, such professionals will be cultivated who can work to resolve complex issues with the advanced expertise of electrical and electronic engineering, and can lead new R&D and adjust spontaneously in response to social changes, such as Society 5.0.

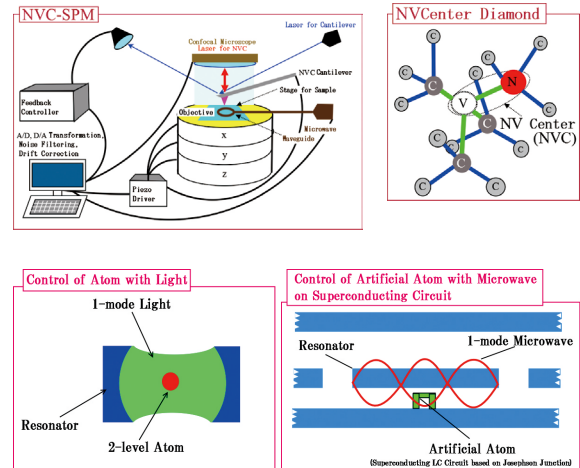
Those in the Department of Electronic Engineering aim to be such researchers and technicians and accept students who are highly motivated and possess the basic academic skills required to learn by themselves as well as strive to develop new areas of technology and new academic disciplines.



Department of I&E Visionaries

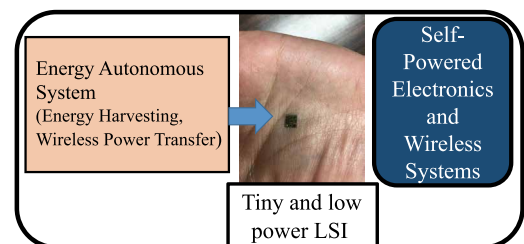
I&E Quantum Computer Science and Technology Group

We make the theoretical study on the physical, engineering problems arising from the control of qubits in quantum computing and quantum sensing. Regarding quantum computation: we study the mathematical structure of several quantum information devices. For instance, the (artificial) 2-level atom controlled with light or microwave is among them. We also make the theoretical research on the modeling of the system of the part from the low phases of quantum compiler to the quantum architecture. Regarding quantum sensing: we study on the computer-control technology such as the control technology of the NVC sensor and the noise-filtering technology to detect faint quantum information buried in several noises. We uphold this theme in the development of the measurement device with the quantum sensor. We aim for implementation of the computer-control technology in the measurement device.



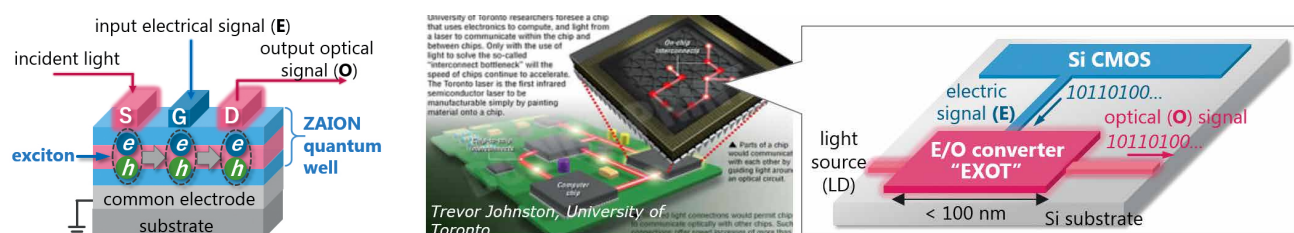
I&E Analog LSI & System Group

Demand of a reliable high speed wireless technology that transfers the data/information economically at low power has been increasing faster than ever. This is inherent not only of next generation smart phones/iPhones but also to realize the Cyber Physical Systems (CPS) and Internet of things (IoT)) where semiconductor or LSI technology plays a vital role in the hardware design for the interface between physical and cyber layers. To counter this scenario, we have been investigating the possibility of a paradigm shift from a battery-inherent to a battery-free wireless and embedded sensor system. The fundamental techniques include the development of the ultra-low power and low voltage analog/high frequency integrated circuits in CMOS technology, and on the other hand, efforts are going to apply the carrier frequency (of a cell phone) to transfer not only the signal/data but also the power to realize a wire/battery-free and self-powered system to replace the conventional batteries in the future wireless and embedded sensor systems.



I&E Excitonics Research Group

We are developing a new class of transistor "exciton transistor (EXOT)" with a new semiconducting material, $(\text{ZnO})_x(\text{InN})_{1-x}$. Exciton - an electrically neutral quasiparticle- is a bound state of an electron-hole pair attracted by the electrostatic Coulomb force. The most interesting feature of an exciton is that it can be generated by and converted back into a photon within a short time. Thus, EXOTs bring great improvements to the speed of electronic-optical (E/O) conversion along with significant miniaturizations of E/O converters. They will replace electric wiring on computer chips with optics, and lead to high-performance and low-power-consuming data processors!



Courses and Subjects of ISEE

The Curriculum Outline of the Graduate School of Information Science and Electrical Engineering

The social and industrial communities point to the scarcity of information and hardware engineers supporting information systems. The primary objective of the present curriculum revision is to cope with this shortage. Social demands for the educational programs of ISEE can be summarized as follows:

1. Requirements for advanced informatics education to cope with the rapid advancement of science related to information technology due to worldwide networking.
 - Education of researchers and engineers who support technological schemes concerned with contents structuralizing from information.
 - Education of researchers and engineers who support the theoretical backbone of information technology.
2. Requirements for ICT specialists, particularly leading researchers and engineers, triggered by infiltration of the social information foundation.
 - Education of researchers and engineers who support the infrastructure basis of the advanced information system.
 - Education of researchers and engineers who support an advanced information

foundation to enhance awareness of interference with the real world, including real-world information processing.

3. Requirements for education accommodating to technological revolution and extending interdisciplinary research in the field of electrical engineering.
 - Education of researchers and engineers who support the physical layer of information and energy.
 - Education of researchers and engineers who support the interdisciplinary area between the information system and the electrical system.

Education in the graduate school of ISEE is conducted by three departments corresponding to the above subjects. Additional courses, according to the field specialty and the educational method, are established in the department to clarify the details of educational contents. Establishment of the courses enables us to educate a wide variety of engineers to satisfy future industrial needs without reorganization of the department. Fundamental ideas of the curriculum for the Master's and Doctoral courses are as follows:

Characteristic Education Methods

- (a) An advisory committee is organized to provide each student with close personalized guidance (Doctoral Program).
- (b) Real PBL (Project-Based Learning) is introduced for practical education.
- (c) Collaboration with industries is established for nurturing leading ICT engineers and introducing leading-edge technologies to the Master's Program.
- (d) Practical English education is provided through lectures in English and international
- PBL.
- (e) A long-term Internship program is introduced in collaboration with industries.
- (f) Lectures and guidance in PBL are given by engineers who are active at the forefront of Industry.
- (g) Subjects on intellectual property management, entrepreneurship, and engineering ethics are available as graduate school common subjects.
- (h) Practical education on safety and ethics is

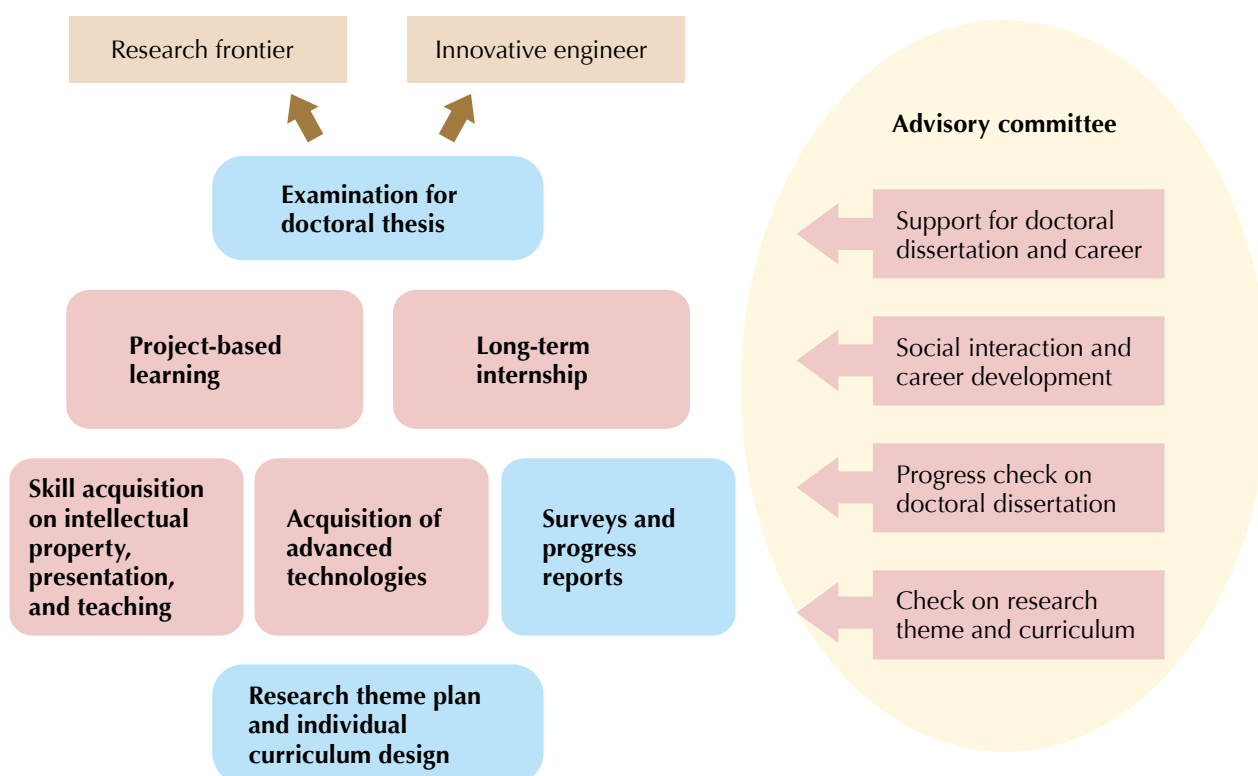
- provided through exercises and experiments.
- (i) Collaboration with the Graduate School of Systems Life Sciences is established.
 - (j) Collaboration with the Graduate School of Mathematics is established to enhance

- education in mathematics.
- (k) Collaboration with the Graduate School of Integrated Frontier Sciences is established to explore new interdisciplinary fields.

Curriculum for Doctoral Course Students

ISEE will organize an advisory committee for each doctoral course student. The advisory committee is composed of several faculty members of ISEE and specialists from companies, universities, and other organizations. The committee first designs an individual curriculum according to the research

theme of the student, then checks his/her progress periodically and suggests appropriate direction. The committee will also offer advice on possible career paths. The curriculum offers opportunities to learn intellectual property and teaching skills and to serve in authorized long-term internships.



Curriculum for doctoral course students

Admissions for International Students

Graduate Programs:

Master's Program

The practical education system established for the Master's Program emphasizes experiments, exercises, discussion, and course work. To develop interdisciplinary intellectual power, each student should select one extended area and take classes from the designated extended subjects in addition to those for his/her major field. Minimum required credits are 45. The completion of a thesis is also required. A two-year program is standard.

Ph. D. Program

Students enrolled in the doctoral course can concentrate on their own research. To support the progress of their research, ISEE will organize an advisory committee for each student composed of several faculty members and specialists from companies, universities, and other organizations. The curriculum offers opportunities to learn intellectual property and teaching skills and to serve in authorized long-term internships. It typically takes three years to complete the program though students can shorten the period depending on their research achievements.

The Global Course:

ISEE opens the Global Course to master's and doctoral students. Students who select this course at the time of entrance can complete their course in English.

Job Opportunities:

There are many job offers for the graduates of ISEE from companies across a wide range of industries in Japan. Ph. D. students can find research positions not only in companies but also in national institutes and universities. The following is a partial list of organizations where *foreign students* have found jobs over the last four years: Asahi Kasei, Buffalo, Daikin, Denso, DNP, Fujitsu, Hitachi, Ibiden, KDDI, Kubota, Kyocera, Mitsubishi, NEC, Nichicon, Nifty, Nikon, Nissan, NTT, Omron, Renesas, SEI, TMEIC, Toshiba Solutions, Ulvac, Yahoo, and others.

Admission:

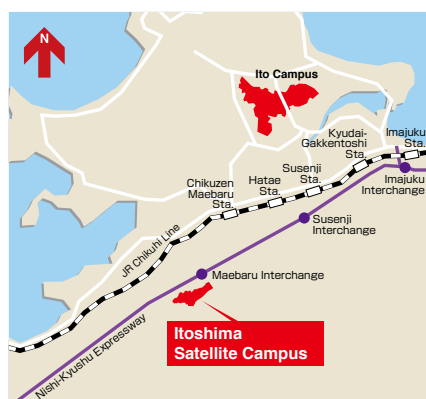
Master's Program

The time of entrance is April and October. Entrance examinations for foreign students are scheduled for August of the previous year and late January. Those who wish to enter should pass either one.

Ph. D. Program

The program begins in April and October with selection scheduled for late February and late July, respectively. Visit website for details.

MAPS



The Graduate School / Faculty of Information Science and Electrical Engineering moved to the new Ito Campus in 2006. The Graduate School / Faculty of Information Science and Electrical Engineering, the System LSI Research Center have a satellite campus in the Momochi area, where IT industries accumulate. The System LSI Research Center also opened a satellite campus in Itoshima area in May 2011 in accordance with the establishment of Experimental Center for Social System Technologies, which is managed by Fukuoka Prefecture.



Graduate School / Faculty of Information Science and Electrical Engineering Kyushu University

<https://www.isee.kyushu-u.ac.jp/>

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