

# For entrants in AY 2021

Appended Form 1

## Specifications for Major Program

Name of School (Program) School of Engineering Cluster 2(Electrical, Electronic and Systems Engineering)

Program name (Japanese)	<input type="checkbox"/>
(English)	<input type="checkbox"/> <input type="checkbox"/> Program of Electronic Devices and Systems

1. Academic Degree to be Acquired Bachelor's degree in engineering

### 2. Overview

In the fields of electricity, electronics, systems, information, and in other related fields, technological innovation has been advancing rapidly. We are now in a situation where innovative technology, ideas, and theories are being produced not only by deepening expert knowledge in a specific area, but by combining expert knowledge from multiple fields. As the impact of such technology on society is getting greater, it is always necessary to keep in mind the relationship between humankind, society, and nature.

On the basis of these social trends, Cluster 2 in the School of Engineering (electricity, electronics, systems, and information) has prepared the following programs with the aim of developing professionals who have a wide range of perspectives and insights, a sense of responsibility, and an ethical outlook, as well as specialized technological, problem-analyzing, and problem-solving abilities.

The Program of Electronic Devices and Systems

The Program of Electrical Systems and Information Engineering

Except for in exceptional circumstances, students who are enrolled in Cluster 2 in the School of Engineering (Electrical, Electronic and Systems Engineering) can choose this program from the above two options at the start of the second year, after going through liberal arts education and specialized education for one year after enrollment.

In the Program of Electronic Devices and Systems, students study electronic engineering centering on semiconductor devices such as integrated circuits.

Semiconductor device technology is one of the central technologies that supports modern society, in which computerization and informatization have been advancing. Today we use a number of devices and types of equipment in daily life and at work, such as audio and video equipment (TVs, video players, etc.) information processing and communication equipment (computers, the internet, mobile phones, etc.), transportation equipment (automobiles), electric home appliances (cooking devices, etc.), medical equipment, manufacturing equipment used in factories, etc., most of which is capable of complicated processing through simple operations using semiconductor devices.  In medical and nursing care equipment, and in robots working at disaster sites, which are expected to become increasingly important in the years to come, operability that can achieve complex movement is more necessary than ever. Therefore, the ability to detect the situation using high performance and high functioning sensors, together with complex information processing using integrated circuits, is indispensable. Furthermore, the realization of judgment processing using artificial intelligence is eagerly awaited.

Meanwhile, considering the energy issues and global environmental problems that are expected to become serious in the future, electronic engineering technology centering on semiconductor devices has a major role to play in resolving many challenges. In order to reduce wasteful energy consumption by the efficient operation of various equipment, the utilization of semiconductor devices, not least solar cells, which are semiconductor devices that generate energy, is absolutely necessary.

Needless to say, new technology to reduce energy consumption by semiconductor devices themselves is also necessary.

To respond to such needs, it is necessary to refine current semiconductor technology through the introduction of new materials and new operating principles, and to develop technology that incorporates other fields. In order to develop professionals who have systematic knowledge and the ability to develop innovative technology, and who can play a central role in solving such challenges, this program offers a curriculum in which students can learn

systematically and extensively, from basic knowledge such as quantum physics and basic semiconductor physics, to the latest research such as high performance electronic devices in nanometer size and high-functioning integrated circuit systems.

The following are the characteristics of the Program of Electronic Devices and Systems.

(1)  Class subjects are arranged to make it possible for students to learn in order the subjects related to each of the fields, physics and materials, semiconductor devices, and integrated systems. Class subjects are also arranged so that the association of subjects in each field is taken into consideration.

(2)  Entry-level subjects and introductory subjects in each field (Introduction to Physical Electronics, Introduction to Semiconductor Devices and Circuits) have been prepared for the second year. Consideration has been given to ensuring that students can see the whole picture in the specialized subject groups that they study. On the other hand, a variety of specialized subjects, including the most advanced science and technology, are offered in the second semester of the third year.

(3)  Subjects concerning physics and solid state physics, which form basis of materials and semiconductor devices, have been designed so that students can learn the basic principles necessary for innovative technological development. Students can also systematically learn the design engineering of integrated circuits from the basics of electrical and electronic circuits to the latest integrated circuits.

(4) This program focuses on acquisition of knowledge, and technical and research ability, in relation to actual "things" such as materials, devices, and ecectath amibnie12.3

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Academic achievement is evaluated based on the grade calculation for each subject and the level of attainment of the goals established by education program.

#### Knowledge/Understanding

Cultivation of the understanding of society-technology relations and the ethical outlook necessary for an engineer ( Goal A ). This is obtained through mastery of liberal arts education subjects such as “Introduction to University Education”, and “Information Subjects”, and basic specialized subjects such as “Introduction to Energy and Information Systems” to be offered in the first year.

Basic knowledge of mathematics, such as differential and integral calculus, and linear algebra, required by scientists and engineers ( Goal B ). This is obtained through mastery of such basic subjects as “Calculus” to be offered in the first year.

Basic knowledge of physical theory and experimental methods required by scientists and engineers ( Goal B ). This is obtained through mastery of basic subjects such as “General Mechanics”, “Experimental Methods and Laboratory Work in Physics” to be offered in the first year.

General understanding and acquisition of knowledge about technologies in the field of electronic systems, and acquisition of the basic knowledge common to this field ( Goal B ). This is obtained through mastery of “Introduction to Energy and Information Systems” and “Electric Circuit Theory I” to be offered in the first year.

#### Abilities/Skills

The mathematical methodology required by experts in the field of electronic systems ( Goal B ). This is obtained through mastery of basic specialized subjects such as “Applied Mathematics” to be offered during the period from the third or fourth term of the first year through the second year.

The concepts, knowledge, and methodology that form the foundation of the field of electronic systems ( Goal B ). This is obtained through mastery of specialized subjects to be offered during the period from the third or fourth term of the first year through the third year.

The ability to apply basic concepts, knowledge, and methodology in the field of electronic systems to concrete, professional issues ( Goal B ). This is obtained through mastery of specialized subjects to be offered during the period from the third or fourth term of the first year through the third year.

The ability to resolve problems and challenges by using experiments to solve practical problems, by using methods of numerical calculation, and by gathering relevant data ( Goal D ). This is obtained through mastery of basic specialized subjects such as “Basic Experiments in Electrical Engineering” and “Programming” to be offered during the period from the first or second term of the second year through the third year.

The ability to make action plans on one's own initiative in relation to practical issues and challenges, make adjustments and resolve problems and challenges by using basic and specialized knowledge and methods ( Goal C, D ). This is obtained through mastery of “Graduation Thesis” to be offered in the fourth year.

#### Comprehensive Abilities

Creative and logical thinking to analyze practical problems and challenges, and to reach rational solutions that meet the requirements of society, as well as the engineering development abilities to physically realize such solutions ( Goal C, D ). These are obtained through mastery of “Graduation Thesis” to be offered in the fourth year.

The ability to organize research results and write logically, including regarding the significance and validity of the obtained outcomes, and to present these research outcomes and discuss them verbally and in an easy-to-understand manner ( Goal E ). This is obtained through mastery of “Graduation Thesis” to be offered in the fourth year.

The teamwork, leadership, and communication abilities needed to work in a group ( Goal E ). These are obtained through mastery of basic specialized subjects such as “Basic Experiments in Electrical Engineering” to be offered during the period from the second year through the third year.

The ability to take an approach to solving various problems after understanding that such problems that exist in humankind, society, and among individuals can be interpreted in various ways depending on social conditions, cultures, etc. ( Goal A, D ). This is obtained through mastery of liberal arts education subjects such as “Basic Language I” and “Area Courses”.

The ability to read, write, converse, and retrieve information in the English language necessary for conducting research ( Goal E ). This is obtained through mastery of “Technical English” to be offered in the third year and “Graduation Thesis” to be offered in the fourth year.

5. Program Timing and Acceptance Conditions

At the beginning of the second year, students are assigned to this program based on consideration of their request and academic results. In order to be assigned to this program, students must acquire a total of 34 or more credits in liberal arts education subjects and specialized education subjects by the end of the first year.

6. Qualifications to be Acquired

By mastering the predetermined courses, students can obtain Type-1 High School Teaching License (Industry). Besides that, by mastering the predetermined class subjects, students are exempted from the examination subjects of the national exams for electrical chief engineers, chief telecommunications engineers and technical radio operators. The details are given in student handbook.

7. Class subjects and course content

- \* For class subjects, see the course list table on the attached sheet.
- \* For course content, see the syllabus for each academic year.

8. Academic Achievements

At the end of each semester, the evaluation criteria are applied to each evaluation item of academic achievement to clearly demonstrate the level of attainment. Students’ grade calculation for each subject from admission to the current semester is given in one of three levels: “Excellent,” “Very Good,” and “Good,” based on evaluation criteria calculated by adding the weighted values to the numerically-converted values of their academic achievements (S = 4, A = 3, B = 2, and C= 1) in each subject being evaluated.

Evaluation of academic achievement	Converted values
S(Excellent: 90 points or higher) <input type="checkbox"/>	<input type="checkbox"/>
A(Superior:80-89 points) <input type="checkbox"/>	<input type="checkbox"/>
B(Good: 70-79 points) <input type="checkbox"/>	<input type="checkbox"/>
C(Fair: 60-69 points)	<input type="checkbox"/> <input type="checkbox"/>

Academic achievement	Evaluation criteria
Excellent	3.00 4.00
Very Good	2.00 2.99
Good	1.00 1.99

- \* See the relationship between evaluation items and evaluation criteria in the attached sheet 2.
- \* See the relationship between evaluation items and class subjects in the attached sheet 3.
- \* See the curriculum map in the attached sheet 4.

9. Graduation Thesis (Graduation Research) (Positioning, When and how to be assigned, etc.)

○ Positioning

Graduation work aims at imparting general research skills by conducting research in line with the research agenda

established for each student. The following are more concrete goals:

1. The acquisition of the ability to make a research plan based on the research agenda and execute the research in accordance with the plan
2. The acquisition of the ability to collect materials related to the research agenda, demonstrate a deep understanding of the research agenda, and identify problems
3. The acquisition of the ability to analyze the problems in the research agenda and reach solutions in accordance with the requirements of society
4. The acquisition of the ability to read, write, converse, and retrieve information in the English language necessary for conducting research

5. The acquisition of the ability to organize research results and write in coherent sentences the significance and validity of the obtained outcomes

6. The acquisition of the ability to present the research outcomes and discuss them verbally in an easy-to-understand manner

○ When and how it is assigned

The requirements for embarking on a graduation thesis are as described in student handbook.

Students in the fourth year or over, who satisfy the requirements for embarking on a graduation thesis, are to be assigned as requested. How adjustments are made in relation to assignment is explained to the applicable students at a briefing held in advance. A briefing session about research topics or an open laboratory is held around the time from February to April for students who are to be assigned to the research laboratory and to the program.

## 10. Responsibility System

### (1) PDCA Responsibility System (“Plan,” “Do,” “Check,” and “Act”)

This program is operated by teachers who support the Program of Electronic Devices and Systems, however, the program targets students who belong to Cluster 2 and, therefore, the person responsible for executing the program is the Cluster 2 leader. Planning, implementing, evaluation, and handling are discussed mainly in the Cluster 2 Education Program committee and in the Cluster 2 committee (held, in principle, on the first Wednesday of every month) in an appropriate manner. Depending on the situation or content, a working group is established at the instruction of the Cluster leader to focus in the issues at hand.

When there is a need to consider the response on a program basis, research laboratory groups responsible for the applicable program take the necessary measures. In that case, the responsible person is appointed by the Cluster leader.

### (2) Program assessment

○ Criteria for Program assessment

Whether or not each class subject is properly allocated in light of the goals of the program, and whether course content is appropriate

Whether or not students taking the course have on average achieved the goal or above

Whether or not the system runs in proper cycles that enable the program to continually improve in an upward spiral

○ How it is assessed

Conducting self-assessment for each subject based on the results of class evaluations carried out by students who have taken the course, and also based on grade calculation results

Regarding the upward spiral of the program, obtaining the questionnaire from graduates in suitable cycles and also collecting the needs from business corporations

○ Position on giving feedback to students and how it is approached

For individual courses, the teacher in charge gives comments on course evaluation results and academic achievement results.

For re-examining the program structure, the reasons for and the purposes of re-examination are given on the website.









Academic Achievements in Electronic Devices and Systems Program  
The Relationship between Evaluation Items and Evaluation Criteria

Academic Achievements		Evaluation Criteria		
Evaluation Items		Excellent	Very Good	Good
Knowledge/Understanding	(1) The ethics and understanding about the relations between society and technology considered basically necessary for engineers.	Sufficiently understand relations between society and technology, and be able to behave with a sufficient sense of ethics.	Understand relations between society and technology at the standard level, and be able to behave with a standard sense of ethics.	Marginally understand relations between society and technology, and be able to behave with a minimum sense of ethics.
	(2) Basic knowledge of mathematics such as calculus and linear algebra, which is required for scientists/engineers.	Acquire and be able to utilize sufficient basic knowledge of mathematics such as calculus and linear algebra.	Acquire and be able to utilize standard basic knowledge of mathematics such as calculus and linear algebra.	Acquire and be able to utilize minimum basic knowledge of mathematics such as calculus and linear algebra.
	(3) Basic knowledge of theories and experimental methods of physics, which is required for scientists/engineers.	Acquire and be able to utilize sufficient basic knowledge of theories and experimental methods of physics.	Acquire and be able to utilize standard basic knowledge of theories and experimental methods of physics.	Acquire and be able to utilize minimum basic knowledge of theories and experimental methods of physics.
	(4) Comprehensive understanding and knowledge of technologies in electronics engineering. Also, basic knowledge which is common in these fields.	Sufficiently acquire and be able to utilize general, common and basic knowledge of electronics engineering.	Acquire and be able to utilize general, common and basic knowledge of electronics engineering, at the standard level.	Marginally acquire and be able to utilize general, common and basic knowledge of electronics engineering.
Abilities/Skills	(1) Mathematical methods required for professionals in electronics engineering.	Sufficiently acquire and be able to utilize mathematical methods which are required for professionals in electronics engineering.	Acquire and be able to utilize mathematical methods which are required for professionals in electronics engineering, at the standard level.	Marginally acquire and be able to utilize mathematical methods which are required for professionals in electronics engineering.
	(2) Concepts, knowledge and methods which are the basis for studies related to electronic engineering.	Sufficiently acquire and be able to utilize concepts, knowledge and methods which are the basis for studies related to electronics engineering.	Acquire and be able to utilize concepts, knowledge and methods of electronics engineering, at the standard level.	Marginally acquire and be able to utilize concepts, knowledge and methods which are the basis for studies related to electronics engineering.
	(3) Ability to apply basic concepts, knowledge, and methods of electronics engineering to concrete/technical problems.	Acquire and be able to utilize sufficient abilities to apply basic concepts, knowledge and methods of electronics engineering to concrete/technical problems.	Acquire and be able to utilize standard abilities to apply basic concepts, knowledge and methods of electronics engineering to concrete/technical problems.	Acquire and be able to utilize marginal abilities to apply basic concepts, knowledge and methods of electronics engineering to concrete/technical problems.
	(4) Ability to solve practical issues and problems by conducting experiments, using numerical computation methods, and collecting relevant materials.	Acquire and be able to utilize sufficient abilities to solve practical issues and problems by conducting experiments, using mathematical methods, and collecting relevant materials.	Acquire and be able to utilize standard abilities to solve practical issues and problems by conducting experiments, using mathematical methods, and collecting relevant materials.	Acquire and be able to utilize marginal abilities to solve practical issues and problems by conducting experiments, using mathematical methods, and collecting relevant materials.
	(5) Ability to solve practical issues and problems by voluntarily making a plan, revising it, and utilizing basic and technical knowledge and methods.	Acquire and be able to utilize sufficient abilities to solve practical issues and problems by voluntarily making a plan, revising it, and utilizing basic and technical knowledge and methods.	Acquire and be able to utilize standard abilities to solve practical issues and problems by voluntarily making a plan, revising it, and utilizing basic and technical knowledge and methods.	Acquire and be able to utilize marginal abilities to solve practical issues and problems by voluntarily making a plan, revising it, and utilizing basic and technical knowledge and methods.
Comprehensive Abilities	(1) Creative thinking ability and logical thinking skills to analyze practical problems and tasks, and to lead to rational solutions satisfying social needs, as well as technical development skills to physically realize the solutions.	Sufficiently acquire and be able to utilize logical thinking skills to lead to rational solutions satisfying social needs and technical development skills to physically realize the solutions.	Acquire and be able to utilize logical thinking skills to lead to rational solutions satisfying social needs and technical development skills to physically realize the solutions, at the standard level.	Marginally acquire and be able to utilize logical thinking skills to lead to rational solutions satisfying social needs and technical development skills to physically realize the solutions.
	(2) Skills to organize research results and to describe them logically including the significance and the effectiveness of the obtained outcomes as well as to make easy-to-understand oral presentations and discussions.	Acquire and be able to utilize sufficient skills to organize research results and to describe them logically including the significance and the effectiveness of the obtained outcomes as well as to make easy-to-understand oral presentations and discussions.	Acquire and be able to utilize standard skills to organize research results and to describe them logically including the significance and the effectiveness of the obtained outcomes as well as to make easy-to-understand oral presentations and discussions.	Acquire and be able to utilize marginal skills to organize research results and to describe them logically including the significance and the effectiveness of the obtained outcomes as well as to make easy-to-understand oral presentations and discussions.
	(3) Teamwork, leadership and communication skills in group works.	Sufficiently acquire and be able to utilize the teamwork, leadership and communication skills for presentations and discussions through solving issues in group works.	Acquire and be able to utilize the teamwork, leadership and communication skills for presentations and discussions through solving issues in group works, at the standard level.	Marginally acquire and be able to utilize the teamwork, leadership and communication skills for presentations and discussions through solving issues in group works.
	(4) Ability to understand that various problems, which humanity, society, and individuals are facing, can be interpreted variously depending on social status, culture and so on, as well as to deal with those problems to solve.	Sufficiently acquire and utilize skills to fully understand that various problems, which humanity, society, and individuals are facing, can be interpreted variously depending on social status, culture and so on, as well as to deal with those problems to solve.	Acquire and utilize skills at the standard level to understand that various problems, which humanity, society, and individuals are facing, can be interpreted variously depending on social status, culture and so on, as well as to deal with those problems to solve.	Marginally acquire and utilize skills to minimally understand that various problems, which humanity, society, and individuals are facing, can be interpreted variously depending on social status, culture and so on, as well as to deal with those problems to solve.
	(5) Ability of English conversation, reading and writing skills necessary for research accomplishment.	Sufficiently acquire and be able to utilize the ability of English conversation, reading and writing skills necessary for engineers.	Acquire and be able to utilize the ability of English conversation, reading and writing skills necessary for engineers, at the standard level.	Marginally acquire and be able to utilize the ability of English conversation, reading and writing skills necessary for engineers.

Placement of the Liberal Arts Education in the Major Program

Liberal Arts Education in this program assumes the role of establishing the academic foundation on which the specialized education for Cluster 2 in the School of Engineering is built. It fosters a willing, self-reliant attitude and cultivates scientific thinking based on data gathering ability, analytical ability, and critical thinking ability. It establishes an outlook that makes it possible to provide insight on the inner nature of things and their background from a broad perspective, and enhances linguistic ability to a level appropriate for living as a world citizen, and also strengthens interest in peace and the ability integrates a broad range of knowledge into a body of knowledge that will be truly useful in solving problems. It cultivates the ability to explore and promote cross-disciplinary and comprehensive research that goes beyond the established frameworks.



Curriculum Map of Electronic Devices and Systems

Academic Achievement		1st grade		2nd grade		3rd grade		4th grade		
Evaluation Items		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	
Knowledge/Understanding	The ethics and understanding about the relations between society and technology considered basically necessary for engineers.	①IT-Introduction to University Education Introduction to Information and Data Sciences	②-Introduction to Energy and Information Systems							
	Basic knowledge of mathematics such as calculus and linear algebra, which is required for scientists/engineers.	Calculus I Linear Algebra I Seminar in Basic Mathematics I	Calculus II Linear Algebra II Seminar in Basic Mathematics II							
	Basic knowledge of theories and experimental methods of physics, which is required for scientists/engineers.	General Mechanics I	General Mechanics II Experimental Methods and Laboratory Work in Physics I							
	Comprehensive understanding and knowledge of technologies in electronics engineering. Also, basic knowledge which is common in these		②-Introduction to Energy and Information Systems Electric Circuit Theory I							
Abilities/Skills	Mathematical methods required for professionals in electronics engineering.		Applied Mathematics I	Applied Mathematics II Applied Mathematics III Probability and Statistics	Synthesis of Applied Mathematics Engineering Mathematics C					
	Concepts, knowledge and methods which are the basis for studies related to electronics engineering.			Programming I	Programming II	Thermodynamics and Statistical Mechanics Robotics				
				Electromagnetism I	Electromagnetism II	Solid State Physics				
				Exercise of Electromagnetism I	Exercise of Electromagnetism II	Signal Processing Engineering				
				Introduction to Physical Electronics Introduction to Semiconductor Devices and Circuits	Quantum Mechanics					
				<1T>Logic System Design	Electric Transient Phenomena					
				Circuit Theory II	Electronic Circuits					
	Ability to apply basic concepts, knowledge, and methods of electronics engineering to concrete/technical problems.			Control Systems Engineering I	Control Systems Engineering II					
					<3T>Digital Circuit Design					
					<3T>Algorithms and Data Structures					
			Exercise of Electromagnetism I	Electromagnetism II	Electromagnetic Wave Propagation	Surface Science and Nanotechnology				
			<1T>Logic System Design	Exercise of Electromagnetism II	Semiconductor Device Engineering	Optoelectronic Semiconductor Devices				
			Circuit Theory II	Electric Transient Phenomena	Electric and Electronic Measurements	Electronic Material Engineering				
Ability to solve practical issues and problems by conducting experiments, using numerical computation methods, and collecting relevant materials.			Control Systems Engineering I	Electronic Circuits	CMOS Logic Circuit Design	Semiconductor Process Engineering				
				Electric Energy Generation and Conversion	Fundamentals of Power Systems	CMOS Integrated Design				
				Control Systems Engineering II	Signal Processing Engineering	Communication Engineering				
				<3T>Digital Circuit Design	Bioelectrical Engineering	<4T>Computer Network				
Comprehensive Abilities	Ability to solve practical issues and problems by voluntarily making a plan, revising it, and utilizing basic and technical knowledge and methods.			<4T>Computer Architecture			<4T>Human Computer Interaction			
				<4T>Databases						
	Ability to solve practical issues and problems by conducting experiments, using numerical computation methods, and collecting relevant materials.			Basic Experiments in Electrical Engineering I	Basic Experiments in Electrical Engineering II	Experiments in Physical Engineering, Electronic and Control Engineering I	Experiments in Physical Engineering, Electronic and Control Engineering II			
				Programming I	Programming II					
	Creative thinking ability and logical thinking skills to analyze practical problems and tasks, and to lead to rational solutions satisfying social needs, as well as technical development skills to physically realize the solutions.							Graduation Thesis	Graduation Thesis	
	Skills to organize research results and to describe them logically including the significance and the effectiveness of the obtained outcomes as well as to make easy-to-understand oral presentations and discussions.		Introductory Seminar for First Year Students						Graduation Thesis	Graduation Thesis
Teamwork, leadership and communication skills in group works.										
Ability to understand that various problems, which humanity, society, and individuals are facing, can be interpreted variously depending on social status, culture and so on, as well as to deal with those problems to solve.		①IT-Introduction to University Education	Area Courses							
		Peace Science Courses	Health and Sports Courses							
		Area Courses								
		Health and Sports Courses								
Ability of English conversation, reading and writing skills necessary for research accomplishment.		Basic language I II								
		Basic English Usage I	Basic English Usage II				Technical English	Graduation Thesis	Graduation Thesis	
		Communication I	Communication II							
	Communication I	Communication II								

Ex Liberal Arts Education Basic Specialized Subjects Specialized Subjects Graduation Thesis