Cyber-Physical System for Smart Society Engineering Program

1. IGP (A) Outline

The goal of this program is to cultivate young and excellent skilled workers who aspire to work globally and aim to accelerate the construction of "Cyber-Physical Systems for Smart Societies," where people can live comfortably and lively. First, students studying in this program will gain a broad and deep understanding of the subjects in the Graduate Major to which they belong. Next, by taking classes offered by other Graduate Majors, students will gain the knowledge and experience needed to join the researchers and engineers working to realize the "Cyber-Physical System for Smart Society" initiative. Through these studies and experiences, students can form a strong network regardless of their nationality. Program graduates are expected to be active not only in Japan but also around the world, where the realization of "Cyber-Physical System for Smart Society" is highly desired.

This means that excellent young researchers and engineers who complete this program will be a cornerstone in supporting the sustainable growth of humanity. Students are educated in the Integrated Doctoral Education Program, where they will transition from the master's program to the doctoral program on a continuous basis for both degrees. Most of the faculty members belonging to the School of Engineering participate in this program. Since the available research fields are very wide, the applicant should carefully consult with the faculty member who will become their supervisor in advance about the consistency between the research theme of the applicant and the purpose of this program. Outlines of each Graduate Majors are given below.

1.   Graduate Major in Mechanical Engineering: This Major aims at fostering human resources who possess systematic expertise constituting basic academic principles of mechanical engineering and creative abilities to solve problems in society. Through this education program, graduates contribute to the advancement of science and technology for broad societal problems.

2.   Graduate Major in Systems and Control Engineering: Our lives, as well as the various equipment and infrastructure that support us are made up of different elements. However, the ability to achieve these and the values that are conceived transcend the individual elements to make an overall system. In this Major, all things and matters in nature and society will be objectively analyzed as systems, and students will cultivate the ability to create systems that have value based on this knowledge. Namely, by learning developmental knowledge of measurement, control, planning, and systems science, this program trains talented people who can specifically apply this knowledge to new topics, are flexibly inventive, creative, and are bold and action-oriented individuals.

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

4.   Graduate Major in Information and Communications Engineering: This major aims 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.

5.   Graduate Major in Industrial Engineering and Economics: Based on the fundamentals of industrial engineering and economics, students learn advanced knowledge and skills in mathematical engineering, economics, human factors/ergonomics, business administration, and management techniques. This program aims to cultivate skilled workers and thinkers with deep insights on technology, organizations, and economies, people with the ability and initiative to discover, investigate, and solve problems in the real world.

[IMPORTANT] Students need to fulfill not only the completion requirements of the Graduate Major they belong to but also the completion requirements set by CPSSS.

1-1. Graduate Major(s) available to IGP (A) Students

Graduate Major in Mechanical Engineering

Graduate Major in Systems and Control Engineering

Graduate Major in Electrical and Electronic Engineering

Graduate Major in Information and Communications Engineering

Graduate Major in Industrial Engineering and Economics

   [NOTE] If a student is in a Graduate Major other than the above, consult with the Supervisor and the Steering Committee of CPSSS.

2. Competencies Developed

In this program, students will acquire the following skills:

- Ability to solve problems using a broad range of engineering knowledge and skills

- Ability to develop a diverse perspective on matters and situations from a well-rounded education and engineering ethics

- Ability to see social trends as well as find and solve current problems in the real world

- Ability to undertake projects with the understating of future trends and a global view by collaborating with others

- Ability to communicate and present using clear, fair, and logical explanations

3. Learning Goals

The student learning goals are as follows:

A) Fundamental knowledge necessary for contributing to the construction of "Cyber-Physical System for Smart Society"

B) Specialized and advanced knowledge necessary for developing "Cyber-Physical System for Smart Society"

C) Interdisciplinary perspective on science and engineering for the realization of "Cyber-Physical System for Smart Society"

D) Creative and practical research abilities

E) Logical communication skills

4. IGP (A) Completion Requirements and Courses

【For Master's degree】

【1.】 IGP (A) Completion Requirements

（1）　Credits

　　a) 2 credits or more must be acquired from the "Common subjects"

　　b) 2 credits or more must be acquired from the subjects provided by each group in the "Specialized subjects" (Three groups x 2 credits = 6 credits),

　　NOTE: The subjects of the department to which the students belongs cannot be counted as "Specialized subjects". The students belonging to the Graduate Major of Industrial Engineering and Economics need to take 2 credits or more on top of the subjects offered in the Cyber Engineering Group or Physical Engineering Group instead of taking the subjects offered in the Social Implementation Group.

　　c) 1 credit or more must be acquired from the "WISE Program for Super Smart Society"

　　e) The seminar requirement be satisfied each semester.

（2）　Thesis

　　The student must complete a special research project, submit a thesis for the degree and take the final examination given after the submission of their thesis. Students qualified through the examination process can enter the Doctoral program with some formalities.

Under this program, in addition to the above-mentioned requirements, students must also fulfill the completion requirements of the Graduate Major to which they belong. For the completion requirements of your Graduate Major, please refer to the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP)".

【2.】 IGP (A) Courses

Table M1 Common subjects

Course category			Course number		Course title		Credits	Competencies	Learning goals	Comments
Common Subject for CPSSS	**400 level**		LAW.X416			Modern Japan	1-1-0	2,3,4,5	A,B,C,D,E	GA0M GA1M
			LAW.X417			Sustainable Engineering Technology	1-1-0	2,3,4,5	A,B,C,D,E	
Industrial Technology Group			LAW.X418			Study on Japanese Companies and Industries I	0-1-0	2,3,5	A,C,D,E	GA0M GA1M
			LAW.X419			Study on Japanese Companies and Industries II	0-1-0	2,3,5	A,C,D,E	GA0M GA1M

Table M2 Specialized subjects

Course category		Course number			Course title	Credits	Competencies	Learning goals	Comments
Physical Engineering Group	400 level	MEC.H434			Advanced Course of Actuator Engineering	1-0-0	1, 5	A, B	
		MEC.G431			Mechanical Processing	1-0-0	1	A	
		EEE.S401			Advanced Electromagnetic Waves	2-0-0	1,5	A	
		EEE.S451			Wireless Communication Engineering	2-0-0	1,5	A	
		EEE.D401			Fundamentals of Electronic Materials	2-0-0	1,5	A	
		ICT.A406			Human-Centric Information Systems I	2-0-0	1,5	A	
		ICT.A418			Human-Centric Information Systems II	2-0-0	1,4,5	A	
	500 level	MEC.J531			Micro and Nano Systems	2-0-0	1	A, B	
		IEE.C533			Affect in Social Context	2-0-0	1,2,3	A, B	
		IEE.C534			Human-Robot Interaction	1-1-0	1,3,4	A, B	
Cyber Engineering Group	400 level	MEC.M434			Space Robotics	1-0-0	1	B	
		SCE.A404			Nonlinear Dynamics	1-0-0	1	A	
		SCE.C451			Optimal Control	1-0-0	1	B	
		SCE.C453			Network Control Systems	1-0-0	1	B	
		ICT.A402			Communications and Computer Engineering I	2-0-0	1	A	
		ICT.A413			Communications and Computer Engineering II	2-0-0	1	A	
		IEE.B401			Advanced Microeconomics	2-0-0	1,5	A	

		IEE.B403	Advanced Noncooperative Game Theory	2-0-0	1	A	
		IEE.B405	Advanced Econometrics	2-0-0	1,5	A	
	500 level	MEC.G531	Precision Manufacturing Processes	1-0-0	1, 5	A, B	
		MEC.H531	Robot Control System Design	1-0-0	1	A, B	
		SCE.I501	Image Recognition	1-0-0	1, 2	C	
Social Implementation Group	**400 level**	IEE.C431	Applied Statistical Analysis	2-0-0	1,5	A	
		IEE.C432	Applied Cognitive Ergonomics	2-0-0	1,3,4,5	A	
		IEE.D431	Distribution and Marketing	2-0-0	1,2,3,5	A	
		IEE.D432	Financial Statement Analysis and Valuation	2-0-0	1,2,3,4,5	A	
		IEE.D434	Corporate Finance and Governance	2-0-0	1,2,3,4,5	A	
		IEE.D435	Computers in Society	1-1-0	2,3,4	A	
WISE Program for Super Smart Society	**400 level**	SSS.S401	Super Smart Society Innovation A1: Frontiers in Quantum Technology	1-0-0			
		SSS.S402	Super Smart Society Innovation A2: IoT/ Robotics / Smart city	1-0-0			
		SSS.S403	Super Smart Society Innovation A3: Frontiers in Smart Agriculture	1-0-0			

Note：

・Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)

・GA0M, GA1M: courses that enable students to acquire GA (Graduate Attributes) and that are recognized as equivalent to Career Development Courses

(For GA (Graduate Attributes) and Career Development Courses, please refer to the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP).)

Under this program, in addition to the above-mentioned requirements, students must also fulfill the Graduate Major completion requirements to which they belong. For the core courses in your Graduate Major, please refer to the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP)".

【**For Doctoral degree**】

【**1.**】 **IGP (A) Completion Requirements**

    a) 4 credits from the Off-Campus Project in the Graduate Major must be acquired.

    b) The seminar requirement must be satisfied in each semester.

    c) The candidate must complete and upload their thesis for the degree, as well as take and pass the final examination and evaluation of the thesis.

    The candidate who satisfies the above requirements and passes the final examination is awarded a doctoral degree.

    Under this program, in addition to the above-mentioned requirements, students must also fulfill the completion requirements of the Graduate Major to which they belong. For completion requirements of your Graduate Major, please refer to the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP)".

【**2.**】 **IGP (A) Courses**

Four (4) credits of Off-Campus Project of the Graduate Major must be acquired.

    Under this program, in addition to the above-mentioned requirements, students must also fulfill the completion requirements of the Graduate Major to which they belong. For the core courses of your Graduate Major, please refer to the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP)".