International Graduate Program on Applied Artificial Intelligence and Cyber-Security
【Ver. 3】
1. IGP (A) Outline

Japan is a world leader in both research and practical application in artificial intelligence and cyber security. This program offers overseas students enrollment in five-year doctoral programs that educate them to be a leader of research and development in these field. To this end, the program includes practice-oriented courses in addition to the classroom lectures. Students study using advanced computing environments, and are able to participate in industrial internships and work as teaching assistants in undergraduate courses.

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

Graduate Major in Mathematical and Computing Science

Graduate Major in Computer Science

Graduate Major in Artificial Intelligence

2. Competencies Developed

Students will acquire advanced knowledge of information science and technology, particularly in artificial intelligence and cyber security, including practical applications and communication skills.

3. Learning Goals

Refer to the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP)" for the learning goals. The categories of learning goals shown in Tables M1-1 ~ M1-5 are defined in the relevant Graduate Major pages in "Guide to Graduate Majors (for IGP)".

4. IGP (A) Completion Requirements and Courses

【For Master's degree】

【1.】 IGP (A) Completion Requirements

The following requirements must be met to complete this program.

1. The students must take 8 credits from Subject Area 1-8 defined below. The 8 credits must cover 3 of the 8 areas. Refer to Tables M1-1 ~ M1-4 for the subjects in each course.

2. The students must take either the credit of "~~International Project for System Development~~ International PBL Course on Software Project Management" or the credit of "Attack and Defense on Cybersecurity II".

3. The students are recommended to take the credit of "Internship A or B (Computing)".

Subject Area

1. Mathematics
2. Applied Mathematics
3. Theoretical Computing Science
4. Computer Systems
5. Software
6. Artificial Intelligence
7. Cognitive Engineering
8. Systems Science

Under this program, in addition to the above-mentioned requirements, students must also fulfill the Graduate Major completion requirements of their departments (degree completion requirements). 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

Table M1-1. Core Courses of the Graduate Major in Mathematical and Computing Science

Course category	Subject area	Course number		Course title	Credits
Major courses	400 level	1	MCS.T401	O	Analysis on Continuous Systems	2-0-0
		2	MCS.T402		Mathematical Optimization: Theory and Algorithms	2-0-0
		2	MCS.T403		Statistical Learning Theory	2-0-0
		3	MCS.T405	O	Theory of Algorithms	2-0-0
		4	MCS.T406	E	Distributed Systems	2-0-0
		4	MCS.T407	O	High Performance Computing	2-0-0
		1	MCS.T408	E	Discrete, Algebraic and Geometric Structures I	2-0-0
		1	MCS.T409	O	Applied Functional Analysis	2-0-0
		2	MCS.T410	E	Applied Probability	2-0-0
		TBA	MCS.T414		Topics on Mathematical and Computing Science A	2-0-0
		TBA	MCS.T415		Topics on Mathematical and Computing Science B	2-0-0
		3	MCS.T416	E	Logic and Computation	2-0-0
		4	MCS.T418	O	Practical Parallel Computing	2-0-0
		1	MCS.T419	E	Stochastic differential equations	2-0-0
	500 level	~~5~~	~~MCS.T502~~		~~Functional Programming~~	~~2-0-0~~
		5	MCS.T503	O	Programming Language Design	2-0-0
		1	MCS.T504	E	Topics in Geometry	2-0-0
		1	MCS.T505	O	Discrete, Algebraic and Geometric Structures II	2-0-0
		2	MCS.T507	O	Theory of Statistical Mathematics	2-0-0
		5	MCS.T509	O	Software Verification	2-0-0
		TBA	MCS.T512		Topics on Mathematical and Computing Science C	2-0-0
		TBA	MCS.T513		Topics on Mathematical and Computing Science D	2-0-0
	Note : • O : odd academic years, E : even academic years • TBA : To be announced (It shall be certified only when it opens in English) • ※ : Available from April 2019 academic year					

Table M1-2. Core Courses of the Graduate Major in Computer Science

Course category	Subject area	Course number		Course title	Credits
Major courses	400 level	7	CSC.T421	O	Human Computer Interaction	2-0-0
		3	CSC.T422	E※	Mathematical Theory of Programs	2-0-0
		5	CSC.T425		Concurrent System Theory	2-0-0
		5	CSC.T426	O	Software Design Methodology	2-0-0
		5	CSC.T431		Advanced System Software	2-0-0
		4	CSC.T433		Advanced Computer Architecture	2-0-0
		3	CSC.T438		Distributed Algorithms	2-0-0
	500 level	4	CSC.T521		Cloud Computing and Parallel Processing	2-0-0
		5	CSC.T523		Advanced Data Engineering	2-0-0
		3	CSC.T524		Dependable Computing	2-0-0
		4	CSC.T526	E	High Performance Scientific Computing	2-0-0
		3	CSC.T527	※	Fault Tolerant Distributed Algorithms	2-0-0

Note :
• O : odd academic years, E : even academic years
• TBA : To be announced (It shall be certified only when it opens in English)
• ※ : Available from April 2019 academic year

Table M1-3. Core Courses of the Graduate Major in Artificial Intelligence

Course category	Subject area	Course number		Course title	Credits
Major courses	400 level	8	ART.T452	※	Modeling of Continuous Systems	1-1-0
		TBA	ART.T454		~~Advanced Topics in Artificial Intelligence AE~~ → Advanced Topics in Artificial Intelligence S	2-0-0
		8	ART.T455	O※	Modeling of Discrete Systems	1-1-0
		8	ART.T456	※	Non-linear Dynamical Systems	2-0-0
		4	ART.T457		Workshop on Building Advanced Computer Network	2-0-0
		6	ART.T458	O	Machine Learning	2-0-0
		~~TBA~~	~~ART.T461~~		~~Advanced Topics in Artificial Intelligence AO~~	~~2-0-0~~
		6	ART.T462		Complex Networks	2-0-0
		7	ART.T463	O※	Computer Graphics	2-0-0
		6	ART.T464		Information Organization and Retrieval	2-0-0
	500 level	8	ART.T542		Studies of Social and Economic Systems	2-0-0
		6	ART.T543		Bioinformatics	2-0-0
		~~TBA~~	~~ART.T544~~		~~Advanced Topics in Artificial Intelligence BE~~	~~2-0-0~~
		2	ART.T545	※	Molecular Simulation	1-1-0
		6	ART.T546		Design Theory in Biological Systems	2-0-0
		6	ART.T547		Multimedia Information Processing	2-0-0
		6	ART.T548		Advanced Artificial Intelligence	2-0-0
		~~TBA~~	~~ART.T549~~		~~Advanced Topics in Artificial Intelligence BO~~	~~2-0-0~~

Note :
• O : odd academic years, E : even academic years
• TBA : To be announced (It shall be certified only when it opens in English)
• ※ : Available from April 2019 academic year

Table M1-4. Advanced Topics in Computing

Course category		Subject area	Course number		Course title	Credits
Major courses	400 level	TBA	XCO.T496	E	Advanced Topics in Computing AE	2-0-0
		TBA	XCO.T497	O	Advanced Topics in Computing AO	2-0-0
		TBA	XCO.T498	E	Advanced Topics in Computing BE	2-0-0
		TBA	XCO.T499	O	Advanced Topics in Computing BO	2-0-0
	Note： • O：odd academic years，E：even academic years • TBA：To be announced (It shall be certified only when it opens in English) • ※：Available from April 2019 academic year					

Table M1-5. Project Based Learning

Course category		Course number		Course title	Credits
Major courses	400 level	CSC.T434		~~International Project for System Development~~ International PBL Course on Software Project Management	0-0-2
		XCO.T476	※	Attack and Defense on Cybersecurity II	1-1-0
	Note： • O：odd academic years，E：even academic years • TBA：To be announced (It shall be certified only when it opens in English) • ※：Available from April 2019 academic year				

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

Courses in Table M1-6 below are also the IGP (A) core courses.

Table M1-6. Core Courses of the Graduate Major in Mathematical and Computing Science, Graduate Major in Computer Science and Graduate Major in Artificial Intelligence (Master's Level, newly added in April 2019)

Course category		Subject area	Course number		Course title	Credits
Major courses	400 level	4	MSC.T412	E	Information Visualization	2-0-0
		3	MSC.T413	O	Quantum Computation and Quantum Information	2-0-0
		1	MSC.T417	O	Topics in Algebra	2-0-0
		7	CSC.T439		Augmented Reality	2-0-0
		6	ART.T459		Natural Language Processing	2-0-0
	500 level	2	MSC.T506	O	Mathematical Models and Computer Science	2-0-0
	Note： • O：odd academic years，E：even academic years					

【For Doctoral degree】

【1.】 IGP (A) Completion Requirements

The following requirements must be met to complete this program. Refer to Table D1-1~D1-3 for the subjects.

1. The students of Graduate major in Mathematical and Computing Science must take 4 credits from Forum on Mathematical and Computing Science S3, F3, S4, F4, S5, F5.

2. The students of Graduate major in Computer Science must take 4 credits from Forum on Computer Science S3, F3, S4, F4, S5, F5.

3. The students of Graduate major in Artificial Intelligence must take 4 credits from Forum on Artificial Intelligence S3, F3, S4, F4, S5, F5.

4. These credits can be used for fulfilling the completion requirements of their departments (degree completion requirements) as well.

5. The students must take either the credit of "ALP Practice I (Teaching Practice)" offered by Liberal arts and basic science courses or the credit of "Introduction to Leadership" offered by ToTAL (Tokyo Tech Academy for Leadership).

6. The students who do not take Internship A or B (Computing) in Master course are recommended to take the credit of "Internship C (Computing)"

Under this program, in addition to the above-mentioned requirements, students must also fulfill the Graduate Major completion requirements of their departments (degree completion requirements). 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

Table D1-1. Core Courses of the Graduate Major in Mathematical and Computing Science

Course category		Course number	Course title		Credits
Major courses	600 level	MCS.U681		Forum on Mathematical and Computing Science S3	0-0-1
		MCS.U682		Forum on Mathematical and Computing Science F3	0-0-1
		MCS.U683		Forum on Mathematical and Computing Science S4	0-0-1
		MCS.U684		Forum on Mathematical and Computing Science F4	0-0-1
		MCS.U685		Forum on Mathematical and Computing Science S5	0-0-1
		MCS.U686		Forum on Mathematical and Computing Science F5	0-0-1
	Note : • O：odd academic years，E：even academic years				

Table D1-2. Core Courses of the Graduate Major in Computer Science

Course category		Course number	Course title		Credits
Major courses	600 level	CSC.U681		Forum on Computer Science S3	0-0-1
		CSC.U682		Forum on Computer Science F3	0-0-1
		CSC.U683		Forum on Computer Science S4	0-0-1
		CSC.U684		Forum on Computer Science F4	0-0-1
		CSC.U685		Forum on Computer Science S5	0-0-1
		CSC.U686		Forum on Computer Science F5	0-0-1

Note : • O : odd academic years,　E : even academic years				

Table D1-3. Core Courses of the Graduate Major in Artificial Intelligence

Course category		Course number	Course title		Credits
Major courses	600 level	ART.U681		Forum on Artificial Intelligence S3	0-0-1
		ART.U682		Forum on Artificial Intelligence F3	0-0-1
		ART.U683		Forum on Artificial Intelligence S4	0-0-1
		ART.U684		Forum on Artificial Intelligence F4	0-0-1
		ART.U685		Forum on Artificial Intelligence S5	0-0-1
		ART.U686		Forum on Artificial Intelligence F5	0-0-1
	Note : • O : odd academic years,　E : even academic years				

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

Revision History

Version Number	Change Description	Effective Date
2.0	Advanced Topics in Artificial Intelligence AE, AO, BE, BO have been updated	Oct 4, 2018
3.0	1.International Project for System Development has changed the name 2. Each major's core course has increased. Please see Table M1-6 3. MCS.T502 Functional Programming is not available from April 2019	Apr 16, 2019