

Graduate Major in Science and Technology for Health Care and Medicine

Recent years have seen striking advances in engineering and technology related to human health, medicine, and environments across the various fields of science and engineering. However, it is almost always the case today that people are educated separately in each specialty; there are few instances of multidisciplinary educational systems. At the same time, issues related to human medicine, health, and environments are becoming more complex and diverse. Addressing these issues demands comprehensive and innovative knowledge and skills beyond conventional frameworks. Integrated learning of advanced and multidisciplinary expertise in the field of science and technology, based on deep understanding of humans and society, is essential.

In this course, areas of specialization including science and engineering, medical and dental science, nursing, medical technology, and health science are functionally integrated in education and research on science and technology for health care and medicine. The aim is to educate individuals to have a deep understanding of people and society, high-level expertise in science and technology, a broad outlook, an ability to think deeply, comprehensive decision-making abilities, a sense of ethics, and a global perspective and international mindset. We also aim to train individuals who have the creativity and leadership to pioneer new fields beyond existing areas of specialization, and can act globally. By promoting exchanges between different fields of specialization, we can also expect to bring new perspectives to each field as well as to create new academic disciplines that look to the future.

【Master's Degree Program】

1. Outline

In addition to expertise in the various fields of science and engineering, the course aims to cultivate multidisciplinary expertise in human science, medical and health science, bioethics, related to environments where people are involved, and the ability to understand other fields, as well as issue-solving skills, problem-solving abilities in society, and communication and leadership abilities. Specifically, through lectures on specialized subjects and cutting-edge technologies related to science and technology for health care and medicine, the course develops researchers and engineers in Science and Technology for Health Care and Medicine who have the necessary knowledge and skills.

In the Master's program, students acquire expertise in Medical and Dental Science and Health Sciences in addition to specialty subjects in science and engineering—Mechanical Engineering, Systems and Control Engineering, Electrical and Electronic Engineering, Information and Communications Engineering, Materials Science and Engineering, Chemical Science and Engineering, Computer Science, Life Science and Technology. The program cultivates people with high intelligence and refinement, a broad outlook, the ability to think deeply, comprehensive decision-making abilities, a strong sense of ethics and technology, and an international mindset. These people will have the ability to identify issues and advanced abilities to solve them, both in the development of cutting-edge technology and in academic research.

Specifically, students will:

1. Systematically learn professional knowledge and skills necessary for advanced research and development in the Science and Technology for Health Care and Medicine field based on professional knowledge of a disciplinary field, which students learned in the undergraduate course.
2. Learn professional knowledge and skills by developing the advanced knowledge and skills that students acquired in their undergraduate.
3. Deepen one's professional ability and creativity through lab seminar, research planning for master's thesis subjects, and master's thesis research.

2. Competencies Developed

In this course, in order to achieve the above objectives, the goal of study is to acquire the following knowledge and abilities:

- Knowledge essential for science and technology for health care and medicine such as human science, medical & health science, bioethics, and the environment in which humans are involved.
- Advanced knowledge and skills of science and technology for health care and medicine in each specialized field.
- Basic learning ability to understand expertise in different fields.
- Ability to challenge the development of new areas through integration of issues and problem solving methods in each area.
- Ability to set issues in relation to society and solve problems by making use of their own technology and creativity.
- Leadership and communication skills that can communicate their thoughts and skills correctly and collaborate to address issues.

3. Learning Goals

To acquire the skills listed in “Competencies Developed”, students in this program will have the following training.

- A) Acquiring fundamental expertise in the field of “Science and Technology for Health Care and Medicine”.

Acquiring fundamental expertise in the research field of “Science and Technology for Health Care and Medicine” through required courses and restricted elective courses in Major Courses.

- B) Acquiring advanced expertise in the field of “Science and Technology for Health Care and Medicine”.

Acquiring advanced professional knowledge and skills through various science and engineering courses in Major Courses of “Science and Technology for Health Care and Medicine”.

- C) Acquiring research-executing skills, problem-solving.

Acquiring research-executing skills and problem-solving skills through Research Seminars, Research-Related Courses as well as performing research in the lab by using obtained expertise.

- D) Acquiring experience in relation to engineering ethics and society.

According to lectures by teachers working in industries, learning ethical and social values relevant to society and research and understanding engineering ethics.

- E) Acquiring communication skills.

Learning advanced communication skills required as international professionals through discussion with researchers in the country and overseas.

- F) Cultivating sophistication in relation to liberal arts and humanities.

Learning liberal arts and humanities required as researchers through Humanities and Social Science Courses, Entrepreneurship Courses.

4. IGP Completion Requirements

The following requirements must be met to complete the Master's Degree Program of this major.

1. Attain a total of 30 credits or more from 400- and 500-level courses.
2. From the courses specified in the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum, you must meet the following requirements (see Table M1 below).
 - You have acquired at least 19 credits from Major courses;
 - You have acquired 8 credits from Research Seminars;
 - You have acquired 2 credits from Research-related Courses;
 - Must acquire 2 credits from required Major Courses and 3 credits from restricted elective Major Courses;
 - Must acquire a minimum of 5 credits from Liberal Arts and Basic Science Courses (3 credits from Humanities and Social Science Courses of which 2 credits must be from 400-level courses and 1 credit from 500-level courses, and 2 credits from Entrepreneurship Courses).
3. Pass the master's thesis review and defense.

Table M1 shows course categories and the number of credits required to complete the Master's Degree Program of this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as “associated learning goals”. Prior to registering courses, students need to fully understand the course goals.

Table M1. Graduate Major in Science and Technology for Health Care and Medicine 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	D, F	
	Entrepreneurship Courses		2 credits		D, F	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					

Core courses	Research seminars	STM Seminar S1 STM Seminar F1 STM Seminar S2 STM Seminar F2 A total of 8 credits, 2 credits each from the above courses.		19 credits	C, E	
	Research-related courses	Research Planning for Master Thesis I of STM Research Planning for Master Thesis II of STM A total of 2 credits			C, E	
	Major courses	Interdisciplinary Research Training of STM A total of 2 credits	3 credits from restricted electives		A, B, D, E	
	Major courses and Research-related courses <u>outside the Science and Technology for Health Care and Medicine</u> standard curriculum					
Total required credits		A minimum of 30 credits including those attained according to the above conditions				
Note		<ul style="list-style-type: none"> • Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level. • For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections. 				

5. IGP Courses

Table M2 shows the Core Courses of the Master's Degree Program in this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

Table M2. Core Courses of the Graduate Major in Science and Technology for Health Care and Medicine

Course category		Course number	Course title		Credits	Competencies	Learning goals	Comments	
Research seminars	400 level	STM.Z491.R	◎	★	STM Seminar S1	0-2-0	1,3,5	C,E	
		STM.Z492.R	◎	★	STM Seminar F1	0-2-0	1,3,5	C,E	
	500 level	STM.Z591.R	◎	★	STM Seminar S2	0-2-0	1,3,5	C,E	
		STM.Z592.R	◎	★	STM Seminar F2	0-2-0	1,3,5	C,E	
Research-related courses	400 level	STM.B471.R	◎	★	Research Planning for Master Thesis I of STM	0-1-0	1,3,5	C,E	
	500 level	STM.B571.R	◎	★	Research Planning for Master Thesis II of STM	0-1-0	1,3,5	C,E	
Major courses	400 level	STM.A401.L		★	Introduction to Biomedical Instrumentation	1-0-0	1,2	B	
		STM.A402.L		★	Introduction to Neural Engineering	1-0-0	1	B	
		STM.A404.L		★	From Data Analytics to Machine Learning	1-0-0	1,2,5	A	
		STM.C401.R	◎	★	Interdisciplinary Research Training of STM	0-0-2	3,4,5	A,C	
		STM.C402.A	○	★	Interdisciplinary Research Fundamentals I of STM	1-0-0	1,5	A	
		STM.C403.A	○	★	Interdisciplinary Research Fundamentals II of STM	1-0-0	1,5	A	
		STM.C404.A	○	★	Outline of Science and Technology for Health Care and Medicine I	1-0-0	1,5	A	
		STM.C405.A	○	★	Outline of Science and Technology for Health Care and Medicine II	1-0-0	1,2	A	
		STM.C431.A	○		Off Campus Training I of STM	0-0-1	1,3,4,5	D	Offered in English as needed
		STM.C441.A	○	★	Presentation for Science and Engineering I	1-0-0	2,3	E	
		STM.C442.A	○	★	Presentation for Science and Engineering II	1-0-0	2,3	E	
		STM.E402.L		★	Modeling of Bio-Systems I	1-0-0	1,5		【Systems and Control Engineering】 (SCE.M402)
		STM.E412.L		★	Fluid Robotics	1-0-0	1,5		【Systems and Control Engineering】 (SCE.S402)

	STM.E434.L		★	Robot Audition and Scene Analysis	1-0-0	1,4,5		【Systems and Control Engineering】 (SCE.I434)
	STM.E435.L		★	Visual and Knowledge Information Processing	1-0-0	1,4,5		【Systems and Control Engineering】 (SCE.I435)
	STM.F431.L		★	Fundamentals of Light and Matter I	2-0-0	1	A	【Electrical and Electronic Engineering】 (EEE.D431)
	STM.F451.L		★	Plasma Engineering	2-0-0	1	A	【Electrical and Electronic Engineering】 (EEE.P451)
	STM.G409.L		★	Optics in Information Processing	1-0-0	1	B	【Information and Communications Engineering】 (ICT.H409)
	STM.G411.L		★	Basic Sensation Informatics	1-0-0	1,5	B	【Information and Communications Engineering】 (ICT.H411)
	STM.G422.L		★	Computational Brain	1-0-0	1	B	【Information and Communications Engineering】 (ICT.H422)
	STM.H402.L		★ E	Characterization of Nanomaterials	2-0-0	1	B	【Materials Science and Engineering】 (MAT.M402) a 4Q course, E, b 1-2Q (Offered in English every year at Tsinghua Univ.)
	STM.H403.L		★	Soft Materials Physics	1-0-0	1,2	B	【Materials Science and Engineering】 (MAT.P403)
	STM.H404.L		★	Soft Materials Functional Physics	1-0-0	1,3	B	【Materials Science and Engineering】 (MAT.P404)
	STM.H407.L		★ E	Advanced Course of Nano- Bionics I	1-0-0	1,2,3,5	B	【Materials Science and Engineering】 (MAT.C407)
	STM.H412.L		★ E	Reliability and Durability of Metals and Alloys	2-0-0	1,4,5	B	【Materials Science and Engineering】 (MAT.M412)
	STM.H413.L		★	Soft Materials Functional Chemistry	1-0-0	1,5	B	【Materials Science and Engineering】 (MAT.P413)
	STM.H417.L		★	Medical Polymers	1-0-0	1,5	B	【Materials Science and Engineering】 (MAT.P417)

		STM.H419.L	★	Biodegradable Polymers	1-0-0	1,5		【Materials Science and Engineering】 (MAT.P419)
		STM.H421.L	★	Biomaterial Functions	1-0-0	1,4,5		【Materials Science and Engineering】 (MAT.C421)
		STM.H422.L	★	Biomaterials and Biointerfaces	1-0-0	1,4,5		【Materials Science and Engineering】 (MAT.C422)
		STM.H424.L	★ E	Organic Materials Design	1-0-0	1,5	B	【Materials Science and Engineering】 (MAT.P422)
		STM.H426.L	★	Thermal Properties of Materials	1-0-0	1,5	B	【Materials Science and Engineering】 (MAT.P426)
		STM.I416.L	★	Catalysis for the Environmental Issues	1-0-0	1	B	【Chemical Science and Engineering】 (CAP.I416)
		STM.I425.L	★	Advanced Biofunctional Chemistry I	1-0-0	1,4,5	B	【Chemical Science and Engineering】 (CAP.A425)
		STM.I426.L	★	Advanced Biofunctional Chemistry II	1-0-0	1,4,5	B	【Chemical Science and Engineering】 (CAP.A426)
		STM.I435.L	★	Advanced Bioprocess Engineering	1-0-0	1,4,5		【Chemical Science and Engineering】 (CAP.C425)
		STM.J455.L	★ O	Modeling of Discrete Systems	1-1-0	1,5	B	【Artificial Intelligence】 (ART.T455)
		STM.J456.L	★	Non-linear Dynamical Systems	2-0-0	1	B	【Artificial Intelligence】 (ART.T456)
		STM.J462.L	★	Complex Networks	2-0-0	1	B	【Artificial Intelligence】 (ART.T462)
		STM.K401.L	★	Molecular and Cellular Biology	2-0-0	1,4	B	【Life Science and Technology】 (LST.A401)
		STM.K404.L	★	International Career Development Basics	1-1-0	2,3,4,5	A,B,C,D, E	【Life Science and Technology】 (LST.B404)
		STM.K405.L	★	Design of Bioactive Molecules	2-0-0	1	B	【Life Science and Technology】 (LST.A405)

		STM.K407.L	★	Science of Metabolism	2-0-0	1,4,5	B	【Life Science and Technology】 (LST.A407)
		STM.K410.L	★	Advanced Neuroscience	2-0-0	1,5	B	【Life Science and Technology】 (LST.A410)
		STM.K411.L	★	Biomolecular Engineering	2-0-0	1,2,5	B	【Life Science and Technology】 (LST.A411)
		STM.K412.L	★	Biomaterial Science and Engineering	2-0-0	1,2,4,5	B	【Life Science and Technology】 (LST.A412)
	○	STM.K417.A	★	Advanced Biological Science and Engineering (Tsinghua University)	2-0-0	1,2,4,5	B	【Life Science and Technology】 (LST.A417) (Intended for Tsinghua Univ. PG students)
		STM.K421.L	★	Functional Life Science	2-0-0	1,2	B, D	【Life Science and Technology】 (LST.A421)
		STM.N402.L	★	Materials simulation	2-0-0	1,4,5	B	【Materials and Chemical Technology】 (TCM.A402)
		STM.N404.L	★	Materials Informatics	2-0-0	1,4,5	B	【Materials and Chemical Technology】 (TCM.A404)
		STM.P407.L	★	Soft Materials Design	1-0-0	1,5	B	【Energy Science and Informatics】 (ESI.J407)
		STM.V403.L	★	Functional Organization of the Human Body	1-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V404.L	★	Pathology	1-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V405.L	★	Oral Health Engineering	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V408.L	★	Immunology	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V410.L	★	Molecular Cell Biology	1-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V411.L	★	Introduction to Medical Neurosciences	2-0-0	1		【Health Sciences and Biomedical Engineering】

		STM.V415.L	★	Disease OMICS Informatics	1-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V416.L	★	Introduction to Chemistry and Biology of Biofunctional Molecules	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V417.L	★	Chemical Biology	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V418.L	★	Special Lectures on Molecular Structures	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V419.L	★	Advanced Biomaterials Science	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V420.L	★	Applied Biomaterials	2-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V422.L	★	Biomedical System Science and Engineering I	1-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.V424.L	★	Basic Human Pathology for Graduate Students	1-0-0	1		【Health Sciences and Biomedical Engineering】
		STM.W402.L	★	Mental Health and Psychiatric Nursing Lecture I	2-0-0	1		【Nursing Innovation Science】
		STM.W404.L	★	International Nursing Development Lecture I	2-0-0	4		【Nursing Innovation Science】
		STM.W405.L	★	International Nursing Development Seminar I	0-2-0	2		【Nursing Innovation Science】
		STM.W409.L	★	International Nursing Research Methodology	2-0-0	3		【Nursing Innovation Science】
500 level		STM.A501.L	★	Nanobio Materials and Devices	2-0-0	1,2	B	
		STM.C501.A	○	★ Advanced Science and Technology for Health Care and Medicine I	1-0-0	1,2,5	A	
		STM.C502.A	○	★ Advanced Science and Technology for Health Care and Medicine II	1-0-0	1,4,5	A	
		STM.C504.L		★ Special Lecture Series IV of STM	1-0-0	1,2,4,5	D	
		STM.C531.A	○	Off Campus Training II of STM	0-0-2	1,3,4,5	D	Offered in English as needed
		STM.C532.A	○	Off Campus Training III of STM	0-0-4	1,3,4,5	D	Offered in English as needed
		STM.C541.A	○	★ International Writing	1-0-0	2,3,4,5	E	
		STM.C542.A	○	★ International Presentation I of STM	0-1-0	1,2,3,4,5	E	
		STM.C543.A	○	★ International Presentation II of STM	0-1-0	1,2,3,4,5	E	

	STM.D531.L		★	Micro and Nano Systems	2-0-0	1	B	【Mechanical Engineering】 (MEC.J531)
	STM.E502.L		★	Modeling of Bio-Systems II	1-0-0	1,5		【Systems and Control Engineering】 (SCE.M502)
	STM.E504.L		★	Advanced Course of Computational Mechanics	1-0-0	1		【Systems and Control Engineering】 (SCE.A504)
	STM.F533.L		★	Fundamentals of Light and Matter IIc	1-0-0	1	B	【Electrical and Electronic Engineering】 (EEE.D533)
	STM.G504.L		★	Medical Image Engineering	2-0-0	1,5	B	【Information and Communications Engineering】 (ICT.H504) Students who have already taken "Medical Image Processing" (old course name) cannot take this course.
	STM.G514.L		★	Mechanisms of Visual Perception	1-0-0	1,5	B	【Information and Communications Engineering】 (ICT.H514)
	STM.H504.L		★	Functional Devices	2-0-0	1,2	B	【Materials Science and Engineering】 (MAT.C504)
	STM.I532.L		★	Advanced Catalytic Reactions	1-0-0	1	B	【Chemical Science and Engineering】 (CAP.T532)
	STM.J545.L		★	Molecular Simulation	1-1-0	1,2	B	【Artificial Intelligence】 (ART.T545)
	STM.J553.L		★	Medical and Health Informatics	2-0-0	1	B	【Artificial Intelligence】 (ART.T553)
	STM.K501.L		★	Biomolecular Analysis	2-0-0	1,5	B	【Life Science and Technology】 (LST.A501)
	STM.K502.L		★	Science of Biological Resources	2-0-0	1,5	B	【Life Science and Technology】 (LST.A502)
	STM.K504.L		★	Medical Biotechnology	2-0-0	1,2,5	B	【Life Science and Technology】 (LST.A504)

outside the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum	STM.C412		△	Field Works for Creative Design	1-1-0	3,4,5	D,E	
	STM.C423		★	Industrial design	1-1-0	2,3,4,5	C,E,F	
	STM.C511		△	Practical Creative Design	1-2-0	3,4,5	C,D,E	
	STM.C512		△	Management for Business Creation	0.6-0-0.4	1,2,3,4,5	D,E	

Note :

- ◎ : Required course, ○ : Restricted elective, ★: Course given in English, O : Odd academic years, E : Even academic years
- △ : Progressive graduate minor of "Practical-Based Entrepreneurship Education Course".
- 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)
- 【 】 Course offered by 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:Major Courses, B:Research-related, C:Common Major Courses, D:Mechanical Engineering, E:Systems and Control Engineering, F:Electrical and Electronic Engineering, G:Information and Communications Engineering, H:Materials Science and Engineering, I:Chemical Science and Engineering, J:Artificial Intelligence, K:Life Science and Technology, L:Technology and Innovation Management, M:Engineering Sciences and Design, N:Materials and Chemical Technology, O:Academy for Super Smart Society, P:Energy Science and Informatics, R:Recurrent Program, T:Medical and Dental Sciences, U:Biomedical Sciences and Engineering, V:Health Sciences and Biomedical Engineering, W:Nursing Innovation Science, Z:Research seminars

6. IGP Courses That Can Be Counted as Humanities and Social Science Courses

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the master's degree program, students must attain at least two credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table M-1 of the "Entrepreneurship Courses" listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table M3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program.

It must be noted that credits attained from courses that are recognized as equivalent to Entrepreneurship Courses can be counted towards the completion requirements of the master's degree program, either for Major Courses or for Entrepreneurship

Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.

The Graduate Attributes of the Master's Degree Program are listed in Table M-1 as follows:

GA0M: You can clearly plan your own career and recognize the abilities necessary for realizing it while considering ethics and relevance to societal problems.

GA1M: You can acquire the knowledge, skills, ethics and entrepreneurship necessary for realizing your planned career and contribute to societal problem-solving while collaborating with other experts

Table M3. Courses of the Graduate Major in Science and Technology for Health Care and Medicine recognized as equivalent to Entrepreneurship Courses, and Entrepreneurship Courses

Course category	Course number	Course title		Credits	GA*	Learning goals	Comments	
Courses that can be counted as Entrepreneurship Courses	STM.C411	○	△	Fundamentals of Creative Design	1-1-0	GA0M/ GA1M	A,C	
	STM.C412		△	Field Works for Creative Design	1-1-0	GA0M/ GA1M	D,E	outside the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum
	STM.C431	○		Off Campus Training I of STM	0-0-1	GA1M	D	Offered in English as needed
	STM.C511		△	Practical Creative Design	1-2-0	GA0M/ GA1M	C,D,E	outside the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum
	STM.C512		△	Management for Business Creation	0.6-0-0.4	GA0M/ GA1M	D,E	outside the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum

STM.C531	○		Off Campus Training II of STM	0-0-2	GA1M	D	Offered in English as needed
STM.C532	○		Off Campus Training III of STM	0-0-4	GA1M	D	Offered in English as needed
CAP.E422			Presentation Practice	0-1-0	GA1M	E	【Chemical Science and Engineering】
CAP.E521			Researcher Ethics and Engineer Ethics	1-0-0	GA0M	D	【Chemical Science and Engineering】
ENR.J409			Introduction to Intellectual Property System	2-0-0	GA0M/ GA1M	B,C	【Energy Science and Informatics】
LST.A413			Career Development Seminars	2-0-0	GA0M/ GA1M	B,D,E	【Life Science and Technology】
LST.B404		★	International Career Development Basics	1-1-0	GA0M/ GA1M	A,B,C,D,E	【Life Science and Technology】
LST.C401		★	Institutional Training	0-2-0	GA0M/ GA1M	A,B,D,E	【Life Science and Technology】 (Intended for IGP students)
LST.C501			MS Internship 1	0-1-0	GA1M	D,E	【Life Science and Technology】 Offered in English as needed
LST.C502			MS Internship 2	0-2-0	GA1M	D,E	【Life Science and Technology】 Offered in English as needed
LST.C503			MS Internship 3	0-4-0	GA1M	C,D,E	【Life Science and Technology】 Offered in English as needed
LST.C504			MS Internship 4	0-6-0	GA1M	C,D,E	【Life Science and Technology】 Offered in English as needed
LST.C506		★	Overseas Research Training 1 (Tsinghua University)	0-1-0	GA0M	B,E	【Life Science and Technology】 (Intended for Tsinghua Univ. PG students)
LST.C507		★	Overseas Research Training 2 (Tsinghua University)	0-1-0	GA1M	B,E	【Life Science and Technology】 (Intended for Tsinghua Univ. PG students)

Entrepreneurship Courses	STM.R401		Masters' Recurrent Program 1-1 of STM	0-0-1	GA0M/ GA1M	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)
	STM.R402		Masters' Recurrent Program 1-2 of STM	0-0-1	GA0M/ GA1M	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)
	STM.R501		Masters' Recurrent Program 2 of STM	0-0-2	GA0M/ GA1M	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)

○: course from this major, ★: course given in English

Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

***GA: Graduate Attributes**

8. Research Related to the Completion of Master's Theses

In the Master's thesis research, students experience the research process and aim to improve problem-setting abilities, problem-solving abilities and communication skills. An example of the flow of the Master's thesis research for this is shown below. The evaluation of the academic outcome is carried out as appropriate. Students also consider the course plan as related to direction of their thesis research.

- Presentation of Research Plan and Interim Presentation

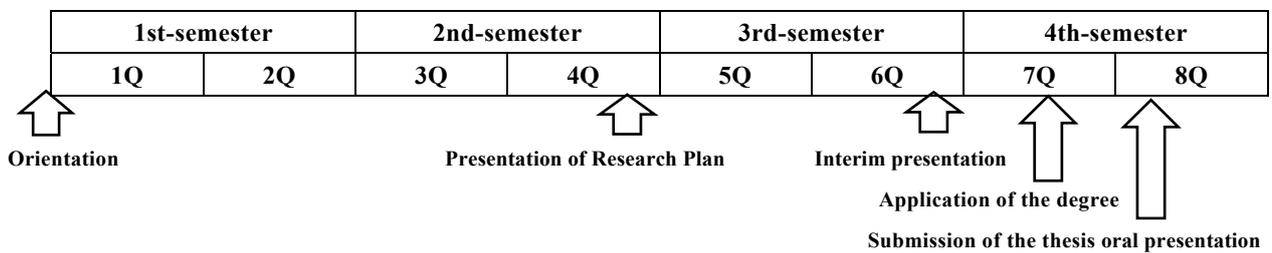
It is important to conduct research systematically and check the progress to produce research results. Students conduct "Presentation of Research Plan" (Research Planning for Master Thesis I) in 4Q and "Interim presentation" (Research Planning for Master Thesis II) in 6Q to understand their research background and purpose clearly.

- Master's Thesis Review Criteria

The Master's thesis and its overview must be a self-authored thesis written in English. The thesis must include the student's original consideration, and also include new findings in the Science and Technology for Health Care and Medicine field or useful research that contributes to the development of the Science and Technology for Health Care and Medicine field.

- Master's Thesis Review Procedure

After preliminary review by the examiner, oral presentations will be made for final review and evaluation. The oral presentations must be given in English.



9. Seamless Transition between Degree Programs

In the Science and Technology for Health Care and Medicine course, we cultivate people who have the basic academic skills to deeply understand people and society and high-level, multidisciplinary expertise in science and technology, a broad outlook and ability to think deeply, comprehensive decision-making abilities, a strong sense of ethics and technology, and a global perspective and international mindset. These people will be able to advance original and challenging cutting-edge research and development, and will have the creativity and leadership to pioneer new fields beyond existing areas of specialization and the ability to act globally. The learning objectives for this are to acquire the following abilities:

- Basic expertise to be able to integrate a wide range of specialty fields and understand specialties in other academic disciplines as needed for a multidisciplinary understanding of science and technology for health care and medicine.
- The ability to address complex problems, uncover and identify issues, and develop research plans.
- The communication and leadership abilities needed to advance international research.

In the curriculum for the doctoral course, in the 600 series, Research Planning for Doctoral Thesis I of STM, Research Planning for Doctoral Thesis II of STM, STM Seminar S1~F5, Teaching methods for Science and Technology for Health Care and Medicine, STM International Internship, International Presentation III & IV of STM, Research Working in Company of STM, STM off-campus advanced training I & II have been established, not only for improvement of expertise through cutting-edge research based on the curriculum from the 400 series. It is an organic curriculum that can effectively improve communication skills and leadership skills.

【Doctoral Degree Program】

1. Outline

With the expertise in science, engineering and dental/medical fields, and the multidisciplinary expertise that is essential to research and development in science and technology for health care and medicine that was obtained prior to the Master's program as a foundation, students will acquire the ability to examine the essence and universality of individual issues, leading to solutions. At the same time, the program develops outstanding individuals who have the ability to take on the challenge of pioneering new fields, display international leadership, and contribute to human well-being and the development of science and technology.

Specifically, students will:

1. Acquire advanced professional knowledge in their own research field through lab seminars and research planning for doctoral thesis subjects, and cultivate a wide range of outstanding expertise and ethics in the field of Science and Technology for Health Care and Medicine.
2. Foster leadership skills, internationality and communication skills in teaching methods and international presentation subjects, and obtain career experience by conducting international internships and research in company subjects.
3. Foster outstanding creativity, task-setting abilities and problem-solving skills that can lead the international community through conducting the world's highest level of research in doctoral thesis research.

2. Competencies Developed

The learning objective of this Doctoral course is to acquire the following abilities and knowledge to a higher standard than the Master's course in order to achieve the goals listed above:

- Knowledge about natural sciences, bioethics, the foundation of health, medical and environmental sciences necessary for research and development in the science and technology for health care and medicine field.
- Advanced professional knowledge and skills related with science and technology for health care and medicine in each disciplinary field.
- Fundamental expertise that can understand different disciplinary knowledge.
- Ability to challenge and explore new research & development areas.
- The ability to identify issues in society and solve these issues by using one's skills and creativity.
- Communication and leadership skills that enable one to accurately convey their ideas and skills to others and collaborate on tasks.

3. Learning Goals

To acquire the skills listed in "Competencies Developed", students in this program will have the following training:

A) Acquiring fundamental expertise in the field of "Science and Technology for Health Care and Medicine".

Acquiring fundamental expertise in the research field of "Science and Technology for Health Care and Medicine" through required courses and restricted elective courses in Major Courses.

B) Acquiring advanced expertise in the field of "Science and Technology for Health Care and Medicine".

Acquiring advanced professional knowledge and skills through science, engineering and dental/medical courses in Major Courses of "Science and Technology for Health Care and Medicine".

C) Acquiring research-executing skills, problem-solving.

Acquiring research-executing skills and problem-solving skills through Research Seminars, Research-Related Courses, as well as research working in lab by using obtained expertise.

D) Acquiring experience in relation to engineering ethics and society.

According to lectures by teachers working in industries, learning ethical and social values relevant to society and research and understanding engineering ethics.

E) Acquiring communication skills.

Learning advanced communication skills required as international professionals through discussion with researchers in the country and overseas.

F) Cultivating sophistication in relation to liberal arts and humanities.

Learning liberal arts and humanities required as researchers through Humanities and Social Science Courses, Entrepreneurship Courses.

4. IGP Completion Requirements

The following requirements must be met to complete the Doctoral Degree Program of this major.

1. Attain a total of 24 credits or more from 600-level courses.
2. From the courses specified in the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum, you must meet the following requirements (see Table D1 below):
 - You have acquired 12 credits from Research Seminars;
 - You have acquired 4 credits from Research-related Courses;
 - Must acquire a minimum of 2 credits from restricted elective Major Courses;
 - Must acquire a minimum of 6 credits from Liberal Arts and Basic Science Courses (2 credits from Humanities and Social Science Courses, and 4 credits from Entrepreneurship Courses).
3. Pass the doctoral dissertation review and defense.

Table D1 shows course categories and the number of credits required to complete the Doctoral Degree Program of this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as “associated learning goals”. Prior to registering courses, students need to fully understand the course goals.

Table D1. Graduate Major in Science and Technology for Health Care and Medicine 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	D, F	
	Entrepreneurship Courses		4 credits		D, F	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	STM Seminar S3 STM Seminar F3 STM Seminar S4 STM Seminar F4 STM Seminar S5 STM Seminar F5 A total of 12 credits, 2 credits each from the above courses.		18 credits	C, E	
	Research-related courses	Research Planning for Doctoral Thesis I of STM Research Planning for Doctoral Thesis II of STM A total of 4 credits			C, E	
	Major courses		2 credits		A, B, D, E	
	Major Courses and Research-related courses <u>outside</u> the Graduate Major in Science and Technology for Health Care and Medicine standard curriculum					

Total required credits	A minimum of 24 credits including those attained according to the above conditions
Note	<ul style="list-style-type: none"> • Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level. • For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.

5. IGP Courses

Table D2 shows the Core Courses of the Doctoral Degree Program of this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

Table D2. Core Courses of the Graduate Major in Science and Technology for Health Care and Medicine

Course category	Course number	Course title	Credits	Competencies	Learning goals	Comments
Research seminars	STM.Z691.R	◎ ★ STM Seminar S3	0-2-0	1,3,5	C,E	
	STM.Z692.R	◎ ★ STM Seminar F3	0-2-0	1,3,5	C,E	
	STM.Z693.R	◎ ★ STM Seminar S4	0-2-0	1,3,5	C,E	
	STM.Z694.R	◎ ★ STM Seminar F4	0-2-0	1,3,5	C,E	
	STM.Z695.R	◎ ★ STM Seminar S5	0-2-0	1,3,5	C,E	
	STM.Z696.R	◎ ★ STM Seminar F5	0-2-0	1,3,5	C,E	
Research-related	STM.B671.R	◎ ★ Research Planning for Doctoral Thesis I of STM	0-2-0	1,2,3,4,5	C,E	
	STM.B672.R	◎ ★ Research Planning for Doctoral Thesis II of STM	0-2-0	1,2,3,4,5	C,E	
Major courses	STM.C601.A	○ Teaching methods for Science and Technology for Health Care and Medicine	1-0-1	1,3,4,5	C,E	Offered in English as needed
	STM.C631.A	○ ★ STM International Internship	0-0-4	1,2,3,4,5	B,C,D	
	STM.C632.A	○ Research Working in Company of STM	0-2-2	1,5	B,C,D	
	STM.C633.A	○ STM off-Campus advanced training 1	0-0-1	1,2,3,4,5	B,C,D	Offered in English as needed
	STM.C634.A	○ STM off-Campus advanced training 2	0-0-2	1,2,3,4,5	B,C,D	Offered in English as needed
	STM.C635.L	○ Cooperative Education through Research Internships of STM	0-0-4	1,3,4,5	B,C,D	Offered in English as needed

	STM.C641.A	○	★	International Presentation III of STM	0-1-0	1,2,3,4,5	E	
	STM.C642.A	○	★	International Presentation IV of STM	0-1-0	1,2,3,4,5	E	
	STM.K605.A	○	★	International Career Development Advanced	1-1-0	1,2,3,4,5	A,B,C,D,E	【Life Science and Technology】 (LST.B605)
	STM.U601.L		★	Biomedical Science	2-0-0	1		【Biomedical Sciences and Engineering】
	STM.U602.L		★	Tissue Regenerative Bioceramic Materials Science	1-0-0	1		【Biomedical Sciences and Engineering】
	STM.U603.L		★	Organic Biomaterials Science	1-0-0	1		【Biomedical Sciences and Engineering】
	STM.U604.L		★	Mathematical and numerical methods for biomedical information analysis	1-0-0	1		【Biomedical Sciences and Engineering】
	STM.U605.L		★	Advanced Biosensing Devices	1-0-0	1		【Biomedical Sciences and Engineering】
	STM.U606.L		★	Advanced Medical Device and System	1-0-0	1		【Biomedical Sciences and Engineering】
	STM.U607.L		★	Wearable & IoT Devices and Applications	1-0-0	1		【Biomedical Sciences and Engineering】
	STM.U608.L		★	Advanced Chemical Biology	1-0-0	1		【Biomedical Sciences and Engineering】

Note :

- ◎ : Required course, ○ : Restricted elective, ★ : Course given in English
- 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)
- 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.D600.R): B: Research-related, C: Common Major Course, K: Life Science and Technology, U: Biomedical Sciences and Engineering, Z: Research seminars

6. IGP Courses That Can Be Counted as Humanities and Social Science Courses

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least four credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table D-1 of the “Entrepreneurship Courses” listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table D3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program.

It must be noted that credits attained from courses that are recognized as Entrepreneurship Courses can be counted towards the completion requirements of the doctoral degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.

The Graduate Attributes of the Doctoral Degree Program are listed in Table D-1 as follows:

GA0D: You can clearly design your own career and contribute to realizing scientific, technological, or social innovation through a comprehensive understanding of the knowledge, skills, social responsibilities and ethics required to become an active member of academia and/or industry.

GA1D: You can lead in realizing scientific, technological, or social innovation by acquiring advanced leadership skills, entrepreneurship, knowledge and expertise, and by developing social responsibility necessary for materializing your designed career.

Table D3. Courses of the Graduate Major in Science and Technology for Health Care and Medicine recognized as equivalent to Career Development, and Entrepreneurship Courses

Course category	Course number			Course title	Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	STM.C631	○	★	STM International Internship	0-0-4	GA1D	B,C,D	
	STM.C632	○		Research Working in Company of STM	0-2-2	GA1D	B,C,D	for Graduate Program for Working Adults students
	STM.C633	○		STM off-Campus advanced training 1	0-0-1	GA1D	B,C,D	Offered in English as needed
	STM.C634	○		STM off-Campus advanced training 2	0-0-2	GA1D	B,C,D	Offered in English as needed
	STM.C635			Cooperative Education through Research Internships of STM	0-0-4	GA0D/ GA1D	B,C,D	
	LST.B605	○	★	International Career Development Advanced	1-1-0	GA0D/ GA1D	A,B,C,D,E	【Life Science and Technology】

	LST.C601		PhD Internship 1	0-1-0	GA1D	A,C,E	【Life Science and Technology】 Offered in English as needed
	LST.C602		PhD Internship 2	0-2-0	GA1D	A,C,E	【Life Science and Technology】 Offered in English as needed
	LST.C603		PhD Internship 3	0-4-0	GA1D	A,B,C,E	【Life Science and Technology】 Offered in English as needed
	LST.C604		PhD Internship 4	0-6-0	GA1D	A,B,C,E	【Life Science and Technology】 Offered in English as needed
Entrepreneurship Courses	STM.R601		Doctoral Recurrent Program 1 of STM	0-0-1	GA0D/ GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)
	STM.R602		Doctoral Recurrent Program 2-1 of STM	0-0-2	GA0D/ GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)
	STM.R603		Doctoral Recurrent Program 2-2 of STM	0-0-2	GA0D/ GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)

	STM.R604			Doctoral Recurrent Program 3 of STM	0-0-3	GA0D/ GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)
	STM.R605			Doctoral Recurrent Program 4 of STM	0-0-4	GA0D/ GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Science and Technology for Health Care and Medicine. (Cannot be counted for Major Courses)

○: course from this major, ★: course given in English

Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

***GA: Graduate Attributes**

The Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the center that offers the relevant program.

8. Research Related to the Completion of Doctoral Theses

In the doctoral thesis research, in addition to problem-solving skills, we foster problem setting ability and improvement of communication skills in English. These are acquired in the process of setting and evaluating the results of the studies. An example of the flow of the doctoral thesis is shown below.

- Interim Presentation

It is important to conduct research systematically and check the progress to produce research results. Thus, students conduct Research Planning for Doctoral Thesis I in 4Q, and Research Planning for Doctoral Thesis II in 9Q-11Q.

- Judgement Criterion of the Final Defense of Doctoral Thesis

Those who wish to conduct the final defense of their doctoral thesis must undergo prior examination at Research Planning for Doctoral Thesis II and obtain the approval to apply for it.

• The Doctoral Thesis Review Criteria

The doctoral thesis must be a self-authored thesis written in English. The content of the thesis must have novelty, creativity, and sufficient academic value in the field of Science and Technology for Health Care and Medicine, and also major parts of the content must be published in international academic journals or the same level as the contents in international journals.

• The Doctoral Thesis Review Procedure

After passing the interim review, the thesis shall be submitted for oral presentation, followed by preliminary review and evaluation by the examiners. In the final review, the ability to understand the relevant field (including English proficiency) will be confirmed. The oral presentation of the doctoral thesis must be given in English.

