Graduate Major in Chemical Science and Engineering

【Master's Degree Program】

1. Outline

Master's Degree Program in the Graduate Major in Chemical Science and Engineering aims at fostering human resources, who have basic academic skills and logical thinking ability in chemical science and engineering and related fields, and can contribute to developing environmentally-benign society by applying their science and engineering wisdom.

This Master's Degree Program aims at training international engineers and leading scientists, who can understand the relationship between "Science and Technology", "Industrials", and "Environment", acquire advanced expert knowledge in chemistry, well-rounded accomplishment, and international communication skills. In order to achieve this goal, the Master's Degree Program consists of "major course" and "research". The former contains advanced academic subjects in the fields of applied chemistry, polymer chemistry, and chemical engineering. For the latter, students acquire indispensable knowledge and education as advanced researchers.

The purpose of this Master's Degree Program contains training international leading chemistry researchers and engineers, who can understand fundamental properties and reactivities of materials in atomic/molecular level, acquire advanced knowledge of chemical engineering systems for transformation to useful materials involving polymers, and solve critical issues in any field by using expertise in chemical science and engineering.

2. Competencies Developed

In this Master's Degree Program, students will be able to acquire the following abilities:

- Systematical knowledge of science and technology focusing on materials, chemical transformation, and process system development
- Practical and problem-solving skills to promote academic research and technology development
- International communication and presentation skills to explain their research logically
- Ability to see the social trends, and find and solve current problems

3. Learning Goals

In this Master's degree program, students are expected to study the following contents to acquire the "Competencies Developed" mentioned above.

Ａ）Basic learning of specialized fields in chemical science and engineering

Learning including fundamental courses which provide wide scope of applied chemistry, macromolecular science, and chemical engineering, and introduction courses which provide basic knowledge for addressing social issues

Ｂ）Advanced learning of chemical science and engineering

Acquisition of deep specialized knowledge and applied skills through the lectures and exercises in the various optional courses including advanced fundamental learnings

C） Learning which cultivates the wide scope and initiative

Acquisition of ability to address the issues autonomously through research by using specialized knowledge and applied skills which acquired from above learnings

D） Learning to relive the social involvement

Learning of reliving studies and engineer ethics through systematic researches and development at the host agency such as institute and company, and the specialized courses made by lecturers from social communities

E） Learning to enforce communication skills

Cultivation of student’s presentation skill and sentence constitution ability to communicate importance of their research and significance of results to others logically and accurately

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. Fulfill requirements in Table M1 below.
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 Chemical Science and Engineering 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	
	Career development courses		2 credits from 400- and 500-level		C,D,E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar in Chemical Science and Engineering S1 Seminar in Chemical Science and Engineering F1 Seminar in Chemical Science and Engineering S2 Seminar in Chemical Science and Engineering F2 A total of 4 credits, 1 credit each from the above courses.		20 credits	B,C,D,E	
	Research-related courses		2 credits		B,C,D,E	
	Major courses		14 credits		A,B	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Chemical Science and Engineering standard curriculum					

Total required credits	**A minimum of 30 credits including those attained according to the above conditions**
Note	**・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 Chemical Science and Engineering

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	400 level	CAP.Z491.R	◎		Seminar in Chemical Science and Engineering S1	0-1-0	2,3,5	A,C,E	
		CAP.Z492.R	◎		Seminar in Chemical Science and Engineering F1	0-1-0	2,3,5	A,C,E	
	500 level	CAP.Z591.R	◎		Seminar in Chemical Science and Engineering S2	0-1-0	2,3,5	A,C,E	
		CAP.Z592.R	◎		Seminar in Chemical Science and Engineering F2	0-1-0	2,3,5	A,C,E	
Research-related courses	400 level	CAP.E431.L			Introduction to Academic Writing S1	0-1-0	1,2,4,5	B,E	
		CAP.E432.L			Introduction to Academic Writing F1	0-1-0	1	B,E	
		CAP.E411.L			Advanced Internship in Chemical Science and Engineering I	0-0-1	1,2,5	B,D	
		CAP.E412.L			Advanced Internship in Chemical Science and Engineering II	0-0-2	1,2,5	B,D	
		CAP.E451.L			Research Methodology in Chemical Science and Engineering I	0-1-0	2,3,5	C,E	
	500 level	CAP.E551.L			Research Methodology in Chemical Science and Engineering II	0-1-0	2,3,5	C,E	
Major courses	400 level	CAP.A421.L		□	Advanced Design of Organic Reaction Processes I	1-0-0	3,5	A	
		CAP.A422.L		□	Advanced Design of Organic Reaction Processes II	1-0-0	3,5	B	

		CAP.A466.L		E □	Advanced Bioinorganic Chemistry II	1-0-0	3	B	
		CAP.A471.L		□	Advanced Solid State Chemistry Oriented for Energy and Environment Issues I	1-0-0	3,4,5	B	【Energy Science and Engineering】(ENR.H407)
		CAP.A472.L		□	Advanced Solid State Chemistry Oriented for Energy and Environment Issues II	1-0-0	3,4,5	B	【Energy Science and Engineering】(ENR.H408)
		CAP.C411.L		□	Chemical Engineering for Advanced Materials and Chemicals Processing I	1-0-0	3,5	A	
		CAP.C423.L		□	Computational Fluid Dynamics	1-0-0	3,5	B	
		CAP.C431.L		□	Chemical Engineering for Advanced Materials and Chemicals Processing II	1-0-0	3	A	
		CAP.C441.L		□	Transport Phenomena and Operation	2-0-0	1,3,4,5	B	
		CAP.C443.L		□	Advanced Chemical Reaction-Separation Process	1-0-0	3,5	B	
		CAP.I417.L		□	Introduction to Chemical Engineering (Unit Operation)	1-0-0	3,5	A	
		CAP.I473.L		E □	Nanotechnology and Nanoscience	2-0-0	3	B	
		CAP.I438.L		□	Functionalized Nano-Materials Chemistry I	1-0-0	3	B	
		CAP.I472.L		O □	Advanced Course of Catalytic Chemistry	2-0-0	3	B	
		CAP.I474.L		O □	Advanced Electrochemistry	2-0-0	3	B	【Energy Science and Engineering】(ENR.H416)
		CAP.I475.L		O □	Organic Molecular and Macromolecular Chemistry	2-0-0	3	B	【Energy Science and Engineering】(ENR.H417)
		CAP.I476.L		E □	Inorganic Materials Science	2-0-0	3,5	B	【Energy Science and Engineering】(ENR.H418)
		CAP.I477.L		E □	Organic Electrode Process	2-0-0	3,5	B	【Energy Science and Engineering】(ENR.H419)
		CAP.I445.L		□	Functionalized Nano-Materials Chemistry II	1-0-0	3	B	
		CAP.P467.L		O	Advanced Course of Polymer Chemistry A	1-0-0	3	B	
		CAP.P468.L		O	Advanced Course of Polymer Chemistry B	1-0-0	3	B	

		CAP.P461.L		O	Advanced Course in Organic and Soft Materials Chemistry A	1-0-0	3	B	【Materials Science and Engineering】(MAT.P461)
		CAP.P462.L		O	Advanced Course in Organic and Soft Materials Chemistry B	1-0-0	3	B	【Materials Science and Engineering】(MAT.P462)
		CAP.P465.L			Advanced Course in Physical Properties of Organic Materials A	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P465)
		CAP.P466.L			Advanced Course in Physical Properties of Organic Materials B	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P466)
		CAP.P463.L			Advanced Course in Surface Properties of Organic Materials A	1-0-0	3	B	【Materials Science and Engineering】(MAT.P463)
		CAP.P464.L			Advanced Course in Surface Properties of Organic Materials B	1-0-0	3	B	【Materials Science and Engineering】(MAT.P464)
		CAP.P473.L		□	Soft Materials Physics	1-0-0	1,3	B	【Materials Science and Engineering】(MAT.P403)
		CAP.P474.L		□	Soft Materials Functional Physics	1-0-0	2,3	B	【Materials Science and Engineering】(MAT.P404)
		CAP.P475.L		O □	Soft Materials Chemistry I	1-0-0	3	B	【Materials Science and Engineering】(MAT.P411)
		CAP.P476.L		O □	Soft Materials Chemistry II	1-0-0	3	B	【Materials Science and Engineering】(MAT.P412)
		CAP.P490.L			Soft Materials	2-0-0	1,2,3,5	B	【Materials Science and Engineering】(MAT.P483)

		CAP.P493.L			Advanced Course of Quantum Chemistry	2-0-0	3	B	【Materials Science and Engineering】(MAT.M421)
		CAP.P494.L		□	Advanced Nano Science	2-0-0	1,3,4,5	B	
		CAP.P495.L		E □	Characterization of Nanomaterials	2-0-0	3	B	【Materials Science and Engineering】(MAT.M402)
		CAP.P496.L		O □	Advanced Solid State Physics	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.M407)
		CAP.I451.L			Organic and Bioorganic Chemistry	2-0-0	3,5	B,D	【Life Science and Technology】(LST.A402)
		CAP.I453.L			Design of Bioactive Molecules	2-0-0	3	B,D	【Life Science and Technology】(LST.A405)
		CAP.I455.L			Science of Metabolism	2-0-0	3,4,5	B,D	【Life Science and Technology】(LST.A407)
		CAP.I454.L			Biomolecular Engineering	2-0-0	1,3,5	B,D	【Life Science and Technology】(LST.A411)
		CAP.I452.L			Biomaterial Science and Engineering	2-0-0	1,3,4,5	B,D	【Life Science and Technology】(LST.A412)
	500 level	CAP.A562.L		O □	Advanced Chemistry of Transition Metal Complexes II	1-0-0	3	B	
		CAP.A521.L		O □	Advanced Molecular Design for Organic Synthesis I	1-0-0	3,5	B	
		CAP.A571.L		□	Advanced Chemical Materials for Energy Issues I	1-0-0	3,4,5	B	【Energy Science and Engineering】(ENR.H501)
		CAP.A572.L		□	Advanced Chemical Materials for Energy Issues II	1-0-0	3,4,5	B	【Energy Science and Engineering】(ENR.H502)
		CAP.C512.L		□	Safety Engineering for Chemical Process	1-0-0	3,5	B	
		CAP.C521.L		□	Chemical Engineering in Global Business	1-0-0	1,2,3,5	B	

		CAP.C531.L		□	Advanced Chemical Equipment Design	2-0-0	3,5	B	
		CAP.C533.L		□	Plasma Chemistry and Plasma Processing	1-0-0	3,4	B	
		CAP.C534.L		□	Advanced Supercritical Fluid Process	1-0-0	3,4	B	
		CAP.C542.L		□	Fine Particle Engineering	1-0-0	3,4	B	
		CAP.C543.L		□	Tribology and Surface Engineering	1-0-0	3,4	B	
		CAP.I551.L			Environmental Microbiology	2-0-0	1,3,4,5	B,D	【Life Science and Technology】(LST.A503)
		CAP.P521.L			Advanced Polymer Physics	1-0-0	3	B	
		CAP.P541.L			Advanced Polymer Design for Energy Materials	1-0-0	3,4,5	B	【Energy Science and Engineering】(ENR.H503)
		CAP.P584.L			Fundamentals of electrochemistry and the application to energy conversion materials	1-0-0	1,2,3,4,5	B	【Materials Science and Engineering】(MAT.P506)
		CAP.P585.L			Analytical and analogical methods to solve the heat transfer equation and the application to infrared image processing	1-0-0	1,2,3,4,5	B	【Materials Science and Engineering】(MAT.P507)
		CAP.P586.L			Nano-Materials Electronics	2-0-0	3,4	B	【Electrical and Electronic Engineering】(EEE.D571)
		CAP.P587.L			Applied Vibrational Spectroscopy	1-0-0	1,2,3,4,5	B	【Materials Science and Engineering】(MAT.P512)

Note：

• ◎：Required course, ○：Restricted elective, O：odd academic years, E：even academic years

• □：Course recognized as equivalent to that of the Academy for Co-creative Education of Environment and Energy Science (ACEEES).

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = 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 (Applied chemistry), C (Chemical engineering), P (Polymer science), I (Interdisciplinary science and technology), E (Others), Z (Research seminars).

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

None

7. IGP Courses That Can Be Counted as Career Development Courses

In order to fulfill the completion requirements for the master's degree program, students must attain at least 2 credits in Career Development Courses, and should satisfy all of the Graduate Attributes (GA) specified in Table MA-1 of the "Career Development Courses" (Liberal Arts and Basic Science Courses) in the Guide to Graduate Education and International Graduate Program. Students will be evaluated in regards to GA achievements at the time of their degree completion. As to the courses with more than one GA, the number of GA stipulated for the courses is considered to be acquired regardless of the credits received for the courses.

Major Courses that enable students to acquire GA and that are recognized as equivalent to Career Development Courses are listed in Table M3 below.

However, it must be noted that credits attained from these courses cannot be counted more than once as Major Courses or Career Development Courses towards the completion requirements for the master's degree program.

For Graduate Attributes, refer to the Guide to the Career Development Courses.
The Graduate Attributes of the Master's Degree Program are listed in Table MA-1 as follows:

C0M: Able to delineate one's career plan clearly and recognize the skills necessary to materialize the plan, also considering its relations to the society

C1M: Able to utilize its own expertise to the development of academia and technology, and work with others with different expertise to contribute to problem-solving

Table M3. Courses of the Graduate Major in Chemical Science and Engineering recognized as equivalent to Career Development Courses

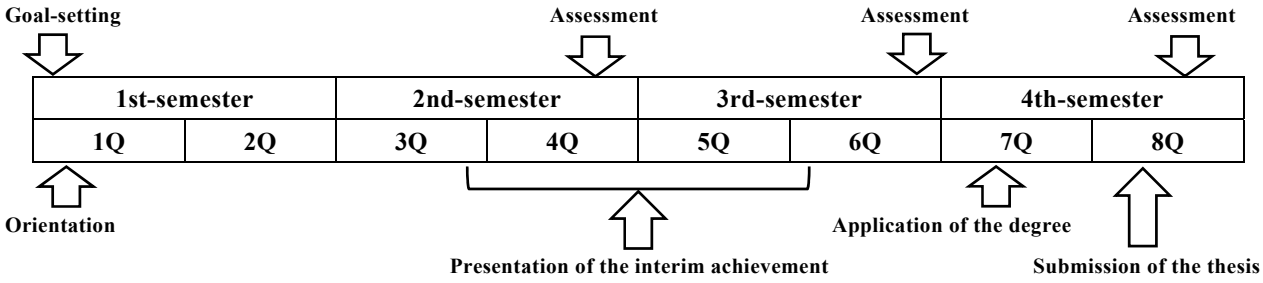
Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	CAP.E411.L			Advanced Internship in Chemical Science and Engineering I	0-0-1	C1M	B,D	
	CAP.E412.L			Advanced Internship in Chemical Science and Engineering II	0-0-2	C1M	B,D	

Credits in Career Development 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 Theses

The research related to the completion of a master thesis, aims at acquiring the basic abilities through an entire research process including goal-setting, problem resolution and basic communications. The following diagram represents a typical example before the final examination. The supervisor makes an assessment of the academic achievements, and reviews an individual course plan with respect to the research orientation and the progress.



・Presentation of the interim achievement

This presentation is for the deeper understanding of own research project with respect to the background, goal and significance.

・Criteria of the examination

Master thesis should contain new and original idea that could contribute to academic or industrial developments in applied chemistry.

・Process of the examination

The final examination is conducted as an oral presentation of the master thesis after a peer-review.

【Doctoral Degree Program】

1. Outline

The purpose of this Doctoral Degree Program is training international leading chemistry researchers and engineers who can understand fundamental properties and reactivities of materials in the atomic/molecular level, acquire highly advanced knowledge of chemical engineering systems for transformation to useful materials involving polymers, acquire an ability for advanced and creative academic research and technology development by using wide range of expertise in chemical science and engineering, possess a vision to establish a novel research field, and contribute to develop environmentally-benign society.

2. Competencies Developed

In this Doctoral Degree Program, students will be able to acquire the following abilities:

- Ability to develop creative academic research and novel technology by highly advanced knowledge in chemical science and engineering
- Ability to understand and elucidate essential fundamental properties, reactivities, and functions of materials in the atomic/molecular level by using highly advanced knowledge in chemical science and engineering
- Creativity to establish a novel research field by using the knowledge in human studies and social science
- Leadership to present guidelines for environmentally-friendly society

3. Learning Goals

In this Doctoral degree program, students are expected to study the following contents to acquire the "Competencies Developed" mentioned above.

Ａ）Acquisition of the advanced specialized knowledge of chemical science and engineering

Acquisition of the world-class specialized knowledge of applied chemistry, macromolecular science, and chemical engineering, and deepening and sharpening of the acquired knowledge through the research seminars

Ｂ）Acquisition of specialized knowledge in interdisciplinary field

Acquisition of ability to expand research into interdisciplinary field by utilizing and applying acquired specialized knowledge in student's own specialized field

Ｃ）Learning of critical thinking skills and practical skills in chemical science and engineering

Acquisition of ability to build and practice leading-edge research theme in student's own research field through academic writing of thesis

Ｄ）Learning to relive the social involvement

Learning of reliving studies and engineer ethics through systematic researches and development at the host agency such as institute and company, and the specialized courses made by lecturers from social communities

Ｅ）Learning to enforce logical thinking and communication skills

Training ability to present student's own research domestically and internationally, and cultivation of the logical

thinking and communication skills to develop an argument with researchers and engineers in various research fields

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. Fulfill requirements in Table D1 below.
3. Pass the doctoral thesis 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 Chemical Science and Engineering 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	B	
	Career development courses		4 credits		C,D,E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar in Chemical Science and Engineering S3 Seminar in Chemical Science and Engineering F3 Seminar in Chemical Science and Engineering S4 Seminar in Chemical Science and Engineering F4 Seminar in Chemical Science and Engineering S5 Seminar in Chemical Science and Engineering F5 A total of 12 credits, 2 credits each from the above courses.		16 credits	A,B,C,D,E	
	Research-related courses				C,D,E	
	Major courses				A,B,C,D	
	Major courses and Research-related Courses <u>outside</u> the Graduate Major in Chemical Science and Engineering standard curriculum					

Total required credits	**A minimum of 24 credits including those attained according to the above conditions**
Note	**・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 Chemical Science and Engineering

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	600 level	CAP.Z691.R	◎		Seminar in Chemical Science and Engineering S3	0-1-1	2,3,5	A,C,E	
		CAP.Z692.R	◎		Seminar in Chemical Science and Engineering F3	0-1-1	2,3,5	A,C,E	
		CAP.Z693.R	◎		Seminar in Chemical Science and Engineering S4	0-1-1	2,3,5	A,C,E	
		CAP.Z694.R	◎		Seminar in Chemical Science and Engineering F4	0-1-1	2,3,5	A,C,E	
		CAP.Z695.R	◎		Seminar in Chemical Science and Engineering S5	0-1-1	2,3,5	A,C,E	
		CAP.Z696.R	◎		Seminar in Chemical Science and Engineering F5	0-1-1	2,3,5	A,C,E	
Major courses	600 level	CAP.E611.L			Academic Writing Practice I	0-1-0	1,5	E	
		CAP.E612.L			Academic Writing Practice II	0-1-0	1,5	E	
		CAP.E621.L			Problem-Solving Program in Chemical Science and Engineering I	0-0-1	1,2,4	B,E	
		CAP.E622.L			Problem-Solving Program in Chemical Science and Engineering II	0-0-1	1,2,4	B,E	
		CAP.E623.L			Problem-Solving Program in Chemical Science and Engineering III	0-0-1	1,2,4	B,E	
		CAP.E624.L			Problem-Solving Program in Chemical Science and Engineering IV	0-0-1	1,2,4	B,E	
		CAP.E631.L			Chemical Science and Engineering Off-Campus Project I	0-0-1	1,2,5	B,D	

		CAP.E632.L			Chemical Science and Engineering Off-Campus Project II	0-0-2	1,2,5	B,D	
		CAP.E633.L			Chemical Science and Engineering Off-Campus Project III	0-0-4	1,2,5	B,D	
		CAP.E634.L			Chemical Science and Engineering Off-Campus Project IV	0-0-6	1,2,5	B,D	
		CAP.I686.L			International scientific presentation A	0-0-1	2,3	B,C,E	【Energy Science and Engineering】(ENR.E604)
		CAP.I687.L			International scientific presentation B	0-0-1	2,3	B,C,E	【Energy Science and Engineering】(ENR.E605)
		CAP.I688.L			International scientific presentation C	0-0-1	2,3	B,C,E	【Energy Science and Engineering】(ENR.E606)
		CAP.I692.L		□	Academic Writing A	1-0-0	2,4	B,E	【Energy Science and Engineering】(ENR.E610)
		CAP.I693.L		□	Academic Writing B	1-0-0	1,2,4	B,E	【Energy Science and Engineering】(ENR.E611)
		CAP.I694.L			International energy project	0-0-2	1,2,4,5	C,E	【Energy Science and Engineering】(ENR.E612)
		CAP.P601.L			Fundamentals of electrochemistry and the application to energy conversion materials (Advanced)	1-0-0	1,2,3,4,5	B	【Materials Science and Engineering】(MAT.P602)
		CAP.P602.L			Applied Vibrational Spectroscopy (Advanced)	1-0-0	1,2,3,4,5	B	【Materials Science and Engineering】(MAT.P603)

Note：

• ◎：Required course, ○：Restricted elective, O：odd academic years, E：even academic years

• □：Course recognized as equivalent to that of the Academy for Co-creative Education of Environment and Energy Science (ACEEES).

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = 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.D600.R): A (Applied chemistry), C (Chemical engineering), P (Polymer science), I (Interdisciplinary science and technology), E (Others), Z (Research seminars).

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

None

7. IGP Courses That Can Be Counted as Career Development Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least 4 credits in Career Development Courses, and should satisfy all of the Graduate Attributes (GA) specified in Table A-1 or A-2 of the "Career Development Courses" (Liberal Arts and Basic Science Courses) in the Guide to Graduate Education and International Graduate Program. Students will be evaluated in regards to GA achievements at the time of their degree completion. As to the courses with more than one GA, the number of GA stipulated for the courses is considered to be acquired regardless of the credits received for the courses.

Major Courses that enable students to acquire GA and that are recognized as equivalent to Career Development Courses are listed in Tables D3-1 and D3-2 below.

However, it must be noted that credits attained from these courses cannot be counted more than once as Major Courses or Career Development Courses towards the completion requirements for the doctoral degree program.

For Graduate Attributes, refer to the Guide to the Career Development Courses.
The Graduate Attributes of the Academic Leader Program (ALP) are listed in Table A-1 as follows:

- A0D: You will be able to precisely draw your own career plan and self-train yourself to acquire the skills required for attaining your goals in the academic field
- A1D: You will be able to ascertain the true nature of phenomena, master the secret of learning, and lead the pioneering of a new academic discipline or research area
- A2D: You will be able to understand the position of academia in society, and adequately explain the academic progress to members of society, which is the stakeholder
- A3D: You will be able to nurture junior students in educational institutions, inculcating in them an interest in academics and enabling them to later join in the pioneering of new academic disciplines or research areas

The Graduate Attributes of the Productive Leader Program (PLP) are listed in Table A-2 as follows:

- P0D: You will be able to precisely draw your own career plan and self-train yourself to acquire the skills required for attaining your goals in the industry, etc.
- P1D: You will be able to precisely grasp the needs of society and detect its problems, and lead the future developments in science and technology
- P2D: While leading teams consisting of members with varied specialties and value systems, you will be able to create products and enterprises that bring forth new values in the society
- P3D: Through the project, you will be able to nurture junior students, enabling them to later join in the development of next generation society and industry

Table D3-1. Courses of the Graduate Major in Chemical Science and Engineering recognized as equivalent to Career Development Courses in the Academic Leader Program (ALP)

Course category	Course number	Course title	Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	CAP.E631.L	Chemical Science and Engineering Off-Campus Project I	0-0-1	A1D, A2D, A3D	B,D	
	CAP.E632.L	Chemical Science and Engineering Off-Campus Project II	0-0-2	A1D, A2D, A3D	B,D	
	CAP.E633.L	Chemical Science and Engineering Off-Campus Project III	0-0-4	A1D, A2D, A3D	B,D	
	CAP.E634.L	Chemical Science and Engineering Off-Campus Project IV	0-0-6	A1D, A2D, A3D	B,D	

Credits in Career Development 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

Table D3-2. Courses of the Graduate Major in Chemical Science and Engineering recognized as equivalent to Career Development Courses in the Productive Leader Program (PLP)

Course category	Course number	Course title	Credits	GA*	Learning goals	Comments
Courses that can be counted as Career Development Courses	CAP.E631.L	Chemical Science and Engineering Off-Campus Project I	0-0-1	P1D, P2D, P3D	B,D	
	CAP.E632.L	Chemical Science and Engineering Off-Campus Project II	0-0-2	P1D, P2D, P3D	B,D	
	CAP.E633.L	Chemical Science and Engineering Off-Campus Project III	0-0-4	P1D, P2D, P3D	B,D	
	CAP.E634.L	Chemical Science and Engineering Off-Campus Project IV	0-0-6	P1D, P2D, P3D	B,D	

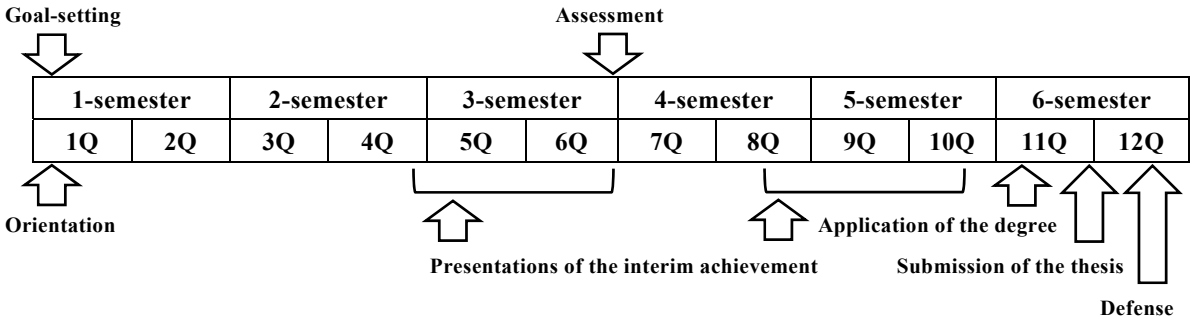
Credits in Career Development Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

＊GA: Graduate Attributes

Students enrolled in the educational program for leading graduate schools or in the Tokyo Tech Academy for Leadership (ToTAL) may be offered courses recognized as equivalent to Career Development Courses besides those listed as such in the "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 Academy that offers the relevant program.

8. Research Related to the Completion of Doctoral Theses

The research related to the completion of a doctoral thesis, aims at acquiring comprehensive ability including goal-setting, problem resolution and international communication at higher level. The following diagram represents a typical example before the final examination.



・Criteria of the examination

Doctoral thesis should be genuinely the work of the candidate containing originality and significance that could contribute to academic or industrial developments in applied chemistry.

・Process of the examination

The doctoral thesis is reviewed by faculty members of the board who can judge the thesis from academic or technical viewpoints. The board can contain external experts from other universities or companies. After submission of the thesis and a public presentation by the candidate, the thesis will be peer-reviewed by the board. The final examination (defense) is conducted for an assessment of the thesis.