Graduate Major in Energy Science and Engineering

【Master's Degree Program】

1. Outline

This degree program takes a holistic approach to graduate education in the Interdisciplinary field of Energy Science and Engineering. It aims to develop energy science and engineering leaders of the future who can solve complex problems using technology, science and engineering.

The Master's Degree Program, for Graduate Major in Energy Science and Engineering teaches students highly technical knowledge based on fundamental disciplines such as physics, chemistry, materials, machinery, and electricity. In addition, this major provides students various skills for evaluating diverse energy-related issues from the viewpoint of multidisciplinary energy sciences, fact-finding, problem solving, and global leadership, which are necessary for innovation in a sustainable society.

2. Competencies Developed

The students will acquire,

- Highly technical knowledge in one of the energy field disciplines (i.e., physics, chemistry, materials science, mechanical engineering, energy based economics and electrical engineering)
- Fundamental technical knowledge in order to understand diverse energy-related topics
- Practical problem-solving skills based on technical knowledge in the energy field
- Ability to work proactively and investigate new energy research related themes
- Ability to find new directions on energy topics by diverse thinking
- Global technical communication skills

3. Learning Goals

The students enrolled in energy science and engineering will learn,

A) Fundamental knowledge in the field of energy science and engineering

A wide variety of energy related coursework will provide students with fundamental knowledge and allow skills development in energy-related disciplines such as physics, chemistry, materials science, mechanical engineering, energy based economics and electrical engineering.

B) Advanced knowledge in the field of energy science and engineering

A wide variety of coursework will provide students an advanced knowledge and skills about energy-related disciplines such as physics, chemistry, materials science, mechanical engineering, energy based economics and electrical engineering.

C) Interdisciplinary view in energy field and problem-solving training

By engaging in original research focused on addressing specific challenges and completing a Master's thesis, students learn to gain an overview of multidisciplinary energy sciences, identify key issues, and solve problems.

D) Understanding ethics and safety

Appreciation of the societal responsibilities as researchers and knowledge on safety concerning technology, research and development as well as ethical practices.

E) Communication Skills

Techical communication skills are developed by both domestic and international collaboration, and by acquiring the ability to evaluate research and anticipate new applications from a global point of view.

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 Energy Science and Engineering curriculum below,
   - a minimum of 25 credits acquired from major courses and research seminars
   - a minimum of 4 credits from “Interdisciplinary Scientific Principles of Energy Courses” and a minimum of 4 credits from the major courses in the department in which the student was admitted. For students in the Department of Chemistry, a minimum of 4 credits from the Chemistry Major Courses (*), and for students in the Department of Transdisciplinary Science and Engineering, a minimum of 4 credits from energy major courses in other departments (either one or more) that offer Graduate Major in Energy Science and Engineering.
   - 8 credits acquired from “Research Seminars” (Seminar in energy science Spring quarters in the 1st year (S1), Fall quarters 1st year (F1), Spring 2nd Year (S2), and Fall 2nd Year (F2)); and
   - A minimum of 5 credits acquired 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 Career Development Courses).
3. Pass the master's thesis exam and oral defense.

Table M1 shows course categories and the number of credits required to complete the Master's Degree Program in 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 objectives”. Prior to registering courses, students need to fully understand the course goals.

Table M1. Graduate Major in Energy 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-levels		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 Energy Science S1 Seminar in Energy Science F1 Seminar in Energy Science S2 Seminar in Energy Science F2 A total of 8 credits, 2 credits each from above courses.		25 credits	B,C,D,E	
	Research-related courses				B,C,D,E	
	Major courses		a minimum of 4 credits from "Interdisciplinary Scientific Principles of Energy Courses" and a minimum of 4 credits from the Major Courses in the student's department. For students in Department of Chemistry, a minimum of 4 credits from the Chemistry major courses (*), and for students in the Department of Transdisciplinary Science and Engineering, a minimum of 4 credits from energy major courses in other departments (either one or more) that offer Graduate		A,B	

			Major in Energy Science and Engineering.			
	Major courses and Research-related Courses <u>outside</u> the Graduate Major in Energy Science 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.** **• For students in the Department of Chemistry, a minimum of 4 credits must come from the Chemistry Course Track marked with '(*)'.**				

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 Energy Science and Engineering

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	400 level	ENR.Z491.R	◎		Seminar in energy science S1	0-0-2	2,3,4,5	A,B,C	
		ENR.Z492.R	◎		Seminar in energy science F1	0-0-2	2,3,4,5	A,B,C	
	500 level	ENR.Z591.R	◎		Seminar in energy science S2	0-0-2	2,3,4,5	A,B,C	
		ENR.Z592.R	◎		Seminar in energy science F2	0-0-2	2,3,4,5	A,B,C	
Research-related courses	400 level	ENR.E491.L		□	Environment Preservation and Chemical Safety I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.E401) Chemical Science and Engineering Course Track
		ENR.E492.L		□	Environment Preservation and Chemical Safety II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.E402) Chemical Science and Engineering Course Track
		ENR.E493.L			Advanced Internship in Chemical Science and Engineering I	0-0-1	1,2,5	B,D	【Chemical Science and Engineering】(CAP.E411) Chemical Science and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
		ENR.E495.L		□	Presentation Practice	0-1-0	2,5	E or B,D	【Chemical Science and Engineering】(CAP.E422) Chemical Science

									and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
	500 level	ENR.B502.L			Energy innovation co-creative project	0-0-1	1,2,3,4,5	A,C,E	
		ENR.B503			Energy Engineering Internship A	0-0-1	1,2,5	C,D,E	Course outside the standard curriculum
		ENR.B504			Energy Engineering Internship B	0-0-2	1,2,5	C,D,E	Course outside the standard curriculum
		ENR.H591.L		□	Scientific Ethics	1-0-0	3,5	D or B,D	【Chemical Science and Engineering】 (CAP.E521) Chemical Science and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
		ENR.B511.L		★	TSE Energy Off-Campus Project S A	0-0-1	3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B512.L		★	TSE Energy Off-Campus Project S B	0-0-1	3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B513.L		★	TSE Energy Off-Campus Project S C	0-0-1	3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B514.L		★	TSE Energy Off-Campus Project S D	0-0-1	3,5	B,C,E	For students affiliated with the

									Department of Transdisciplinary Science and Engineering only
		ENR.B515.L		★	TSE Energy Off-Campus Project L A	0-0-2	2,3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B516.L		★	TSE Energy Off-Campus Project L B	0-0-2	2,3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B517.L		★	TSE Energy Off-Campus Project L C	0-0-2	2,3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B518.L		★	TSE Energy Off-Campus Project L D	0-0-2	2,3,5	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B519.L		★	TSE Energy International Workshop A	0-0-1	2,3	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B520.L		★	TSE Energy International Workshop B	0-0-1	2,3	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B521.L		★	TSE Energy International Workshop C	0-0-1	2,3	C,E	For students affiliated with the Department of Transdisciplinary

									Science and Engineering only
		ENR.B522.L		★	TSE Energy International Workshop D	0-0-1	2,3	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
		ENR.B523.L		★	Special Topics on Fourier Transform and Some of Its Applications	1-0-0	3	要記入	【School of Engineering】 (XEG.S506)
Major courses	**400 level**	Interdisciplinary Principles of Energy Courses 400 Level							
		ENR.A401.A	○	★ □	Interdisciplinary scientific principles of energy 1	1-0-0	3,4,5	A,C	
		ENR.A402.A	○	★ □	Interdisciplinary scientific principles of energy 2	1-0-0	3,4,5	A,C	
		ENR.A403.A	○	★ □	Interdisciplinary principles of energy devices 1	1-0-0	3,5	A,C	
		ENR.A404.A	○	★ □	Interdisciplinary principles of energy devices 2	1-0-0	3,4,5	A,C	
		ENR.A405.A	○	★ □	Interdisciplinary Energy Materials Science 1	1-0-0	3,4,5	A,C	
		ENR.A406.A	○	★ □	Interdisciplinary Energy Materials Science 2	1-0-0	3,4,5	A,C	
		ENR.A407.A	○	★ □	Energy system theory	1-0-0	3,4	A,C	
		ENR.A408.A	○	★ □	Economy of energy system	1-0-0	3,4,5	A,C	
		ENR.B430.L		□	Advanced Science and Technology in Energy and Environment	2-0-0	3,5	A,C	
		ENR.B431.L		★ □	Recent technologies of fuel cells, solar cells, batteries and energy system	1-0-0	1,2,3,4,5	A,C	Open also to Tokyo Tech Summer Program participants
		ENR.B432.L		★ □	Technologies for Energy and Resource Utilization	1-0-0	1,2,3	A,C,D	【Global Engineering for Development, Environment and Society】 (GEG.E404)
		ENR.B433.L		★	Project Design & Management S	0-1-1	1,2,5	B,C,E	【Global Engineering for Development, Environment and

									Society】(GEG.P451)
		ENR.B434.L		★	Project Design & Management F	0-1-1	1,2,4,5	B,C,E	【Global Engineering for Development, Environment and Society】(GEG.P452)
		ENR.B435.L		★ □	The economics and systems analysis of environment, resources and technology	1-0-0	3,4,5	A,B	【Global Engineering for Development, Environment and Society】(GEG.S402)
		ENR.B436.L		□	Special lecture of economics and politics in energy	1-0-0	3,4,5	A,C	
		ENR.B437.L		★	Energy & Environment-1	1-0-0	3,5	A,B,E	【Global Engineering for Development, Environment and Society】(GEG.E421) Open also to Tokyo Tech Summer Program participants
		Chemistry Course Track 400 Level							
		ENR.I401.L		★ □	(*)Basic Concepts of Inorganic Chemistry	2-0-0	3	A	【Chemisty】(CHM.B401)
		ENR.I402.L		★ □	(*)Basic Concepts of Physical Chemistry	2-0-0	3	A	【Chemistry】(CHM.C401)
		ENR.I403.L		★ □	(*)Basic Concepts of Organic Chemistry	2-0-0	3	A	【Chemistry】(CHM.D401)
		ENR.I410.L		★ □	Optical properties of solids	2-0-0	3,4	B	
		ENR.I420.L		★ □	Advanced Lecture on Crystal Structure and Correlation with Properties of Solids	1-0-0	3,5	B	
		ENR.I422.L		□	Global Environmental Chemistry	2-0-0	3	B	【Chemisty】(CHM.B435)
		ENR.I423.L		★ □	Advanced Physical Chemistry	2-0-0	3	B	【Chemistry】(CHM.C431)
		ENR.I424.L		★ □	Advanced Quantum Chemistry	2-0-0	3	B	【Chemistry】(CHM.C432)

		ENR.I425.L		★ □	Advanced Organic Synthesis	2-0-0	3,5	B	【Chemistry】 (CHM.D432)
		ENR.I426.L		★ □	Advanced Organometallic Chemistry	2-0-0	3	B	【Chemistry】 (CHM.D433)
		ENR.I427.L		★	Photochemical Reactions I	1-0-0	3	B	【Chemisty】 (CHM.B436)
		ENR.I428.L		★	Photochemical Reactions II	1-0-0	3	B	【Chemistry】 (CHM.B437)
		ENR.I431.L			Laboratory Training of Synchrotron Radiation Science	0-0-1	3,5	B,D	【Chemistry】 (CHM.A431)
		ENR.I435.L		★	Current Chemistry I	1-0-0	1,2,3	B,D	【Chemistry】 (CHM.A435)
		ENR.I436.L		★	Current Chemistry II	1-0-0	1,2,3	B	【Chemistry】 (CHM.A436)
		ENR.I437.L		★	Current Chemistry III	1-0-0	1,2,3	B	【Chemistry】 (CHM.A437)
		ENR.I438.L		★	Current Chemistry IV	1-0-0	1,2,3	B	【Chemistry】 (CHM.A438)
		ENR.I441.L		★ □	Advanced Separation Science	2-0-0	3,5	B	【Chemistry】 (CHM.B431)
		ENR.I442.L		★ □	Catalytic Chemistry on Solid Surface	2-0-0	3	B	【Chemistry】 (CHM.B433)
		ENR.I443.L		★ □	Advanced Course in Crystal Structure Science	2-0-0	3	B	【Chemistry】 (CHM.B434)
		ENR.I444.L		★ □	Advanced Bioorganic Chemistry	2-0-0	3	B	【Chemistry】 (CHM.D431)
		Mechanical Engineering Course Track 400 Level							
		ENR.K401.L		★	Mechanics of Composite Materials	1-0-0	3	A	【Mechanical Engineering】 (MEC.C431)
		ENR.K402.L		★	Solid Dynamics	1-0-0	3,5	A	【Mechanical Engineering】 (MEC.C433)
		ENR.K411.L		★ □	Advanced Sound and Vibration Measurement	1-0-0	3	A	【Mechanical Engineering】 (MEC.D431)
		ENR.K412.L		★ □	Thermodynamics of Nonequilibrium Systems	1-0-0	3	A	【Mechanical Engineering】 (MEC.E431)
		ENR.K413.L		★ □	Properties of Solid Materials	1-0-0	3	A	【Mechanical Engineering】 (MEC.E432)
		ENR.K414.L		★ □	Advanced Thermal-Fluids Measurement	1-0-0	3,5	A	【Mechanical Engineering】

									(MEC.E433)
		ENR.K421.L		★ □	Computational Thermo-Fluid Dynamics	1-0-0	3	A	【Mechanical Engineering】(MEC.F431)
		ENR.K422.L		★	Mechanical Processing	1-0-0	3	A	【Mechanical Engineering】(MEC.G431)
		ENR.K430.L		★ □	Advanced course of turbulent flow and control	1-0-0	3,5	A	
		ENR.K431.L		★	Metalforming	1-0-0	3	A	【Mechanical Engineering】(MEC.G432)
		ENR.K440.L		★ □	Advanced course of radiation transfer	1-0-0	3,5	A	
		ENR.K441.L		★	Advanced Mechanical Elements	1-0-0	3,5	A	【Mechanical Engineering】(MEC.H431)
		ENR.K450.L		★ O □	Advanced course of combustion physics	1-0-0	3,5	A	O: Taught in English in odd academic years
		ENR.K461.L		★	Mechatronics Device and Control	1-0-0	2,3	A	【Mechanical Engineering】(MEC.H433)
		ENR.K462.L		★ □	Advanced Course of Actuator Engineering	1-0-0	3,5	A	【Mechanical Engineering】(MEC.H434)
		ENR.K471.L		★ □	Ultra-precision Measurement	1-0-0	3	A	【Mechanical Engineering】(MEC.J431)
		ENR.K472.L		★ □	Mechanism and Control for Ultra-precision Motion	1-0-0	3,5	A	【Mechanical Engineering】(MEC.J432)
		ENR.K491.L			Space Systems Design	2-0-0	2,3,4,5	A	【Mechanical Engineering】(MEC.M431)
		ENR.K492.L		★	Space Systems Analysis A	1-0-0	3	A	【Mechanical Engineering】(MEC.M433)
		ENR.K493.L			Space Systems Initiative	2-0-0	2,3,4,5	A	【Mechanical Engineering】(MEC.M435)
		Mechanical Engineering Course Track 500 Level							
		ENR.K501.L		★	Mechanics of High Temperature Materials	1-0-0	3,5	B	【Mechanical Engineering】

									(MEC.C531)
		ENR.K511.L		★	Experimental Modal Analysis for Structural Dynamics	1-0-0	3,5	B	【Mechanical Engineering】(MEC.D531)
		ENR.K521.L		★ □	Plasma Physics	1-0-0	3,5	B	【Mechanical Engineering】(MEC.E531)
		ENR.K530.L		★ □	Advanced course of multiscale thermal-fluid sciences	1-0-0	3	B	
		ENR.K531.L		★ □	Flying Object Engineering	1-0-0	3,5	B	【Mechanical Engineering】(MEC.F531)
		ENR.K532.L		★	Cryogenic Engineering	1-0-0	3,4,5	B	【Mechanical Engineering】(MEC.E532)
		ENR.K561.L		★ □	Rarefied Gas Dynamics	1-0-0	3,5	B	【Mechanical Engineering】(MEC.F532)
		ENR.K562.L		★	Precision Manufacturing Processes	1-0-0	3,5	B	【Mechanical Engineering】(MEC.G531)
		ENR.K572.L		★	Advanced Tribosystem	1-0-0	3	B	【Mechanical Engineering】(MEC.J533)
		ENR.K580.L		★ □	Leading edge energy technology	1-0-0	1,3	B	
		ENR.K591.L		★	Space Systems Analysis B	1-0-0	3	B	【Mechanical Engineering】(MEC.M531)
		ENR.K592.L			Space Systems and Missions	2-0-0	3,4,5	B	【Mechanical Engineering】(MEC.M532)
		Electrical and Electronic Engineering Course Track 400 Level							
		ENR.L401.L		★ □	Mechanical-to-electrical energy conversion	2-0-0	3,5	A	
		ENR.L402.L		□	Utilization of Intelligent Information Resources and Patents	1-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.G401)
		ENR.L404.L		★	Graph Theory with Engineering Application	1-0-0	3	A	【School of Engineering】(XEG.S404)
		ENR.L405.L		★	Topics in Digital VLSI Design	1-0-0	3	A	【School of Engineering】

									(XEG.S405)
		ENR.L410.L		★ □	Introduction to Photovoltaics	2-0-0	3,5	A	
		ENR.L411.L		★ □	Fundamentals of Electronic Materials	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.D401)
		ENR.L412.L		★ □	Semiconductor Physics	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.D411)
		ENR.L413.L		□	Electrical Modeling and Simulation	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.G411)
		ENR.L414.L		★ □	Electric Power and Motor Drive System Analysis	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.P401)
		ENR.L415.L		★ □	Advanced Course of Power Electronics	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.P411)
		ENR.L416.L		□	Advanced Electric Power Engineering	2-0-0	2,3	A	【Electrical and Electronic Engineering】(EEE.P421)
		ENR.L417.L		★ □	Advanced Electromagnetic Waves	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.S401)
		ENR.L441.L		□	VLSI Technology I	2-0-0	3	A	【Electrical and Electronic Engineering】(EEE.C441)
		ENR.L442.L		★ □	VLSI Technology II	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.C442)
		ENR.L443.L		★ □	Bipolar Transistors and Compound Semiconductor Devices	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.D451)
		ENR.L444.L		□	Advanced Power Semiconductor	2-0-0	5	A	【Electrical and

					Devices				Electronic Engineering】(EEE.D481)
		ENR.L445.L		★ ☐	Plasma Engineering	2-0-0	3	A	【Electrical and Electronic Engineering】(EEE.P451)
		ENR.L446.L		★ ☐	Pulsed Power Technology	2-0-0	3,4,5	A	【Electrical and Electronic Engineering】(EEE.P461)
		ENR.L447.L		★ ☐	Wireless Communication Engineering	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.S451)
		ENR.L448.L		☐	Optical Communication Systems	2-0-0	3,5	A	【Electrical and Electronic Engineering】(EEE.S461)
		Electrical and Electronic Engineering Course Track 500 Level							
		ENR.L501.L		★ ☐	Dielectric Property and Organic Devices	2-0-0	3	B	【Electrical and Electronic Engineering】(EEE.D501)
		ENR.L502.L		★ ☐	Magnetic Levitation and Magnetic Suspension	2-0-0	3	B	【Electrical and Electronic Engineering】(EEE.P501)
		ENR.L511.L		★ ☐	Magnetism and Spintronics	2-0-0	3,5	B	【Electrical and Electronic Engineering】(EEE.D511)
		ENR.L530.L		★ ☐	Advanced Functional Electronic devices	2-0-0	1,2,3,4,5	B	
		ENR.L550.L		★ ☐	Nano-Structure Devices	2-0-0	3,5	B	【Electrical and Electronic Engineering】(EEE.D551)
		ENR.L560.L		★ ☐	Terahertz Devices and Systems	2-0-0	3,4,5	B	【Electrical and Electronic Engineering】(EEE.D561)
		ENR.L580.L		★	Advanced Energy Electronics Devices	1-0-0	1,2,3,5	B	【Electrical and Electronic

									Engineering】(EEE.D582)
		Materials Science and Engineering Course Track 400 Level							
		ENR.J401.L		★ □	Advanced Metal Physics	2-0-0	2,3,5	B	
		ENR.J402.L		★ □	Physical Chemistry for High Temperature Processes - Thermodynamics-	1-0-0	3,5	A	
		ENR.J403.L		★ □	Physical Chemistry for High Temperature Processes -Smelting and Refining Processes-	1-0-0	3,5	B	
		ENR.J404.L		★ □	Physical Chemistry for High Temperature Processes -Oxidation of Metals-	1-0-0	3,5	B	
		ENR.J405.L		★ O □	Microstructure Evolution and Diffusion in Metals	2-0-0	3,4,5	B	O: English, E: Japanese
		ENR.J406.L		★ □	Organic Electronic Materials Physics	1-0-0	3	B	
		ENR.J407.L		★ □	Soft Materials Design	1-0-0	3,5	B	
		ENR.J408.L		★ O □	Energy Conversion Ceramics Materials	2-0-0	3	B,C	O: English, E: Japanese
		ENR.J409.L		□	Introduction to Intellectual Property System	2-0-0	1,3,4,5	B,C	
		ENR.J410.L		★ O □	Applied Diffraction Crystallography in Metals and Alloys	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.M401) O: English, E: Japanese
		ENR.J411.L		★ □	Characterization of Nanomaterials	2-0-0	3	B	【Materials Science and Engineering】(MAT.M402)
		ENR.J412.L		★ O □	Environmental Degradation of Materials	2-0-0	3	B	【Materials Science and Engineering】(MAT.M403) O: English, E: Japanese
		ENR.J446.L		★ E □	Transport Phenomena at High Temperature - Momentum and Heat Flow -	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.M426) O: Japanese, E: English

		ENR.J447.L		★ E □	Transport Phenomena at High Temperature - Flow of charged particles in solid -	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.M427) O: Japanese, E: English
		ENR.J414.L		★ E □	Advanced Microstructure Design of Ferrous Materials	2-0-0	1,3,4	B	【Materials Science and Engineering】(MAT.M405) O: Japanese, E: English
		ENR.J415.L		★ O □	Advanced Microstructure Design of Non-ferrous Materials	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.M406) O: English, E: Japanese
		ENR.J416.L		★ □	Advanced Solid State Physics	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.M407)
		ENR.J417.L		★ E □	Quantum Statistical Mechanics	2-0-0	1,3,5	B	【Materials Science and Engineering】(MAT.M408) O: Japanese, E: English
		ENR.J418.L		★ O □	Thermodynamics for Phase Equilibria	2-0-0	3	B	【Materials Science and Engineering】(MAT.M409) O: English, E: Japanese
		ENR.J419.L		★ O □	Deformation and Strength of Solids	2-0-0	3	B	【Materials Science and Engineering】(MAT.M410) O: English, E: Japanese
		ENR.J448.L			Exercise in Materials Design	0-1-0	3,5	B	【Materials Science and Engineering】(MAT.M423)
		ENR.J449.L			Exercise in Physical Metallurgy	0-1-0	3,5	B	【Materials Science and Engineering】(MAT.M424)
		ENR.J450.L		★ O	Recovery, Recrystallization and Texture of Metals	1-0-0	3	B	【Materials Science and Engineering】(MAT.M425) O: English, E: Japanese

		ENR.J421.L		★ □	Organic Optical Materials physics	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P401)
		ENR.J422.L		★ E □	Soft Materials Physical Chemistry	1-0-0	3	B	【Materials Science and Engineering】(MAT.P402) O: Japanese, E: English
		ENR.J423.L		★ □	Soft Materials Physics	1-0-0	1,3	B	【Materials Science and Engineering】(MAT.P403)
		ENR.J424.L		★ □	Soft Materials Functional Physics	1-0-0	2,3	B	【Materials Science and Engineering】(MAT.P404)
		ENR.J427.L		★ E □	Soft Materials Functional Chemistry	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P413) O: Japanese, E: English
		ENR.J428.L		★ □	Soft Materials Function	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P414)
		ENR.J429.L		★ E □	Organic Materials Functional Design	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P421) O: Japanese, E: English
		ENR.J430.L		★ E □	Organic Materials Design	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P422) O: Japanese, E: English
		ENR.J431.L		★ □	Advanced Course in Composite Materials	1-0-0	3	B	【Materials Science and Engineering】(MAT.P423)
		ENR.J432.L		★ □	Advanced Course in Polymer Processing A	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P424)
		ENR.J433.L		★ □	Advanced Course in Polymer Processing B	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P425)
		ENR.J434.L			Materials Engineering and Ecology	1-0-0	2,4,5	D	【Materials Science and Engineering】(MAT.P491)

		ENR.J435.L			Advanced Course in Organic Polymer Science	1-0-0	3	B,C	【Materials Science and Engineering】(MAT.P492)
		ENR.J437.L		★ □	Thermal Properties of Materials	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P426)
		ENR.J438.L		□	Crystals Science	2-0-0	3	B	【Materials Science and Engineering】(MAT.C400)
		ENR.J439.L		□	Advanced Course of Dielectric and Ferroelectric Materials	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.C401)
		ENR.J440.L		★ □	Quantum Physics in Optical Response of Materials	2-0-0	3	B	【Materials Science and Engineering】(MAT.C402)
		ENR.J441.L		□	Advanced Course of Ceramic Thin Film Technology	2-0-0	3,4,5	B	【Materials Science and Engineering】(MAT.C403)
		ENR.J442.L		□	Physics and Chemistry of Semiconductors	2-0-0	1,3,5	B	【Materials Science and Engineering】(MAT.C404)
		ENR.J443.L		□	Advanced Course of Instrumental Analysis for Materials	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.C405)
		ENR.J445.L		★ □	Nuclear Materials and Structures	2-0-0	3	B	【Nuclear Engineering】(NCL.N403)
		Materials Science and Engineering Course Track 500 Level							
		ENR.J501.L		★ O □	Advanced Course of Materials Optics	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.C500) O: English, E: Japanese
		ENR.J502.L		□	Advanced Course of Deformation and Fracture of Engineering Materials	2-0-0	2,3,4,5	B	【Materials Science and Engineering】(MAT.C501)
		ENR.J503.L		□	Advanced Course of Material Development I	2-0-0	3,5	B,C	【Materials Science and Engineering】(MAT.C502)
		ENR.J504.L		★ □	Advanced Course of Material Development II	2-0-0	3	B,C	【Materials Science and Engineering】(MAT.C503)
		ENR.J505.L		★ □	Functional Devices	2-0-0	1,3	B	【Materials Science and Engineering】

									(MAT.C504)
		ENR.J520.L		★	Fundamentals of electrochemistry and the application to energy conversion materials	1-0-0	1,2,3,4,5	B,C	【Materials Science and Engineering】(MAT.P506)
		ENR.J521.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,C	【Materials Science and Engineering】(MAT.P507)
		Chemical Science and Engineering Course Track 400 Level							
		ENR.H403.L		★ □	Advanced Electrochemistry I	1-0-0	3	B	
		ENR.H404.L		★ □	Advanced Electrochemistry II	1-0-0	3,5	B	
		ENR.H405.L		★ □	Advanced Inorganic Materials Chemistry I	1-0-0	3,5	B	
		ENR.H406.L		★ □	Advanced Inorganic Materials Chemistry II	1-0-0	3,5	B	
		ENR.H407.L		★ □	Advanced Solid State Chemistry Oriented for Energy and Environment Issues I	1-0-0	3,4,5	B	
		ENR.H408.L		★ □	Advanced Solid State Chemistry Oriented for Energy and Environment Issues II	1-0-0	3,4,5	B	
		ENR.H410.L		★ □	Topics in Properties of Semiconductors	1-0-0	3,5	B	
		ENR.H411.L		★ □	Topics in Applied Electrochemistry	1-0-0	3,5	B	
		ENR.H415.L		★ □	Introduction to Organic Electrochemistry	1-0-0	3,5	B	
		ENR.H420.L		★ □	Introduction to Photochemistry I	1-0-0	3,5	B	
		ENR.H421.L		★ □	Advanced Electrochemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A441)
		ENR.H422.L		★ □	Advanced Electrochemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A442)
		ENR.H423.L			Advanced Instrumental Analysis	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A481)
		ENR.H424.L			Scope of Chemical Science and Engineering IA	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A401)
		ENR.H425.L			Scope of Chemical Science and	1-0-0	3	B	【Chemical Science

					Engineering IIA				and Engineering】(CAP.A402)
		ENR.H428.L		★ □	Advanced Organic Synthesis I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A423)
		ENR.H429.L		★ □	Advanced Organic Synthesis II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A424)
		ENR.H430.L		□	Introduction to Photochemistry II	1-0-0	3,4,5	B	
		ENR.H431.L		★ □	Advanced Solid State Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A461)
		ENR.H432.L		★ □	Advanced Solid State Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A462)
		ENR.H433.L		★	Advanced Molecular Design of Metal Complexes I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A463)
		ENR.H434.L		★	Advanced Molecular Design of Metal Complexes II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A464)
		ENR.H435.L		★ □	Advanced Bioinorganic Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A465)
		ENR.H436.L		★ □	Advanced Bioinorganic Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A466)
		ENR.H439.L		★ □	Advanced Solid-state Physical Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A443)
		ENR.H440.L		★ □	Advanced Solid-state Physical Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A444)
		ENR.H441.L		★ □	Advanced Polymer Synthesis I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.P411)
		ENR.H442.L		★ □	Advanced Polymer Synthesis II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.P412)
		ENR.H443.L		★ □	Special Lecture on Characterization of Polymer Structures and Properties	1-0-0	3	B	【Chemical Science and Engineering】(CAP.P421)
		ENR.H444.L		★	Advanced Polymer Properties	1-0-0	3	B	【Chemical Science

				□					and Engineering】(CAP.P422)
		ENR.H447.L		□	Advanced Technology for Environmental Load Reduction I	1-0-0	1,3,5	A,C	【ACEEES】(ACE.B441)
		ENR.H448.L		□	Advanced Technology for Environmental Load Reduction II	1-0-0	1,3,5	A,C	【ACEEES】(ACE.B442)
		ENR.H450.L		★	Environmentally-Friendly Polymer Chemistry	1-0-0	3,5	B	
		ENR.H451.L		★ □	Process Systems Engineering	2-0-0	3,4,5	B	【Chemical Science and Engineering】(CAP.C412)
		ENR.H452.L		★ □	Advanced Energy Transfer Operation	2-0-0	3,4,5	B	【Chemical Science and Engineering】(CAP.C421)
		ENR.H453.L		★ □	Advanced Chemical Reaction Engineering	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.C424)
		ENR.H494.L		★ □	Advanced Bioprocess Engineering	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.C425)
		ENR.H454.L		★ □	Computational Fluid Dynamics	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.C423)
		ENR.H455.L		★ □	Physico-Chemical Property Analysis in Chemical Engineering	1-0-0	3,4	B	【Chemical Science and Engineering】(CAP.C432)
		ENR.H495.L		★ □	Phase Equilibrium Analysis in Chemical Engineering	1-0-0	3,4	B	【Chemical Science and Engineering】(CAP.C433)
		ENR.H456.L		★ □	Transport Phenomena and Operation	2-0-0	1,3,4,5	B	【Chemical Science and Engineering】(CAP.C441)
		ENR.H458.L		★ □	Chemical Engineering for Advanced Materials and Chemicals Processing I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.C411)
		ENR.H459.L		★ □	Chemical Engineering for Advanced Materials and Chemicals Processing II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.C431)
		ENR.H461.L		★ □	Advanced Organometallic Chemistry and Catalysis I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.T431)
		ENR.H462.L		★ □	Advanced Organometallic Chemistry and Catalysis II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.T432)

		ENR.H463.L		★ □	Introduction to Polymer Science	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.I426)
		ENR.H464.L		★ □	Introduction to Polymer Physical Properties I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I436)
		ENR.H465.L		★ □	Introduction to Polymer Chemistry	2-0-0	3,4,5	B	【Chemical Science and Engineering】(CAP.I427)
		ENR.H466.L		★ □	Introduction to Polymer Physical Properties II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I437)
		ENR.H467.L		★	Advanced Organometallic Chemistry and Catalysis	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I439)
		ENR.H471.L		★ □	Advanced Coordination Chemistry	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I403)
		ENR.H472.L		★ □	Environmental Chemistry	2-0-0	3,5	B	【Chemical Science and Engineering】(CAP.I405)
		ENR.H473.L		★ □	Introduction to Chemical Engineering (Basics)	1-0-0	3,5	A	【Chemical Science and Engineering】(CAP.I407)
		ENR.H474.L		★ □	Advanced Supramolecular Science	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I420)
		ENR.H475.L		★ □	Analytical Techniques for Environmental Chemistry	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.I419)
		ENR.H476.L		★ □	Catalysis for the Environmental Issues	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I416)
		ENR.H477.L		★ □	Introduction to Chemical Engineering (Unit Operation)	1-0-0	3,5	A	【Chemical Science and Engineering】(CAP.I417)
		ENR.H478.L		★ □	Advanced Organic Materials Chemistry	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I423)
		ENR.H479.L		★ □	Advanced Geochemistry	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.I435)
		ENR.H480.L		★	Nano-Surface Chemistry and Advanced Devices	1-0-0	1,3,5	B	【Chemical Science and Engineering】

									(CAP.I446)
		ENR.H481.L		★ □	Functionalized Nano-Materials Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I438)
		ENR.H482.L		★ □	Functionalized Nano-Materials Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I445)
		ENR.H485.L		★ □	Nanotechnology and Nanoscience	2-0-0	3	B	【Chemical Science and Engineering】(CAP.I473)
		ENR.H486.L			Scope of Chemical Science and Engineering IB	1-0-0	3	A	【Chemical Science and Engineering】(CAP.I401)
		ENR.H487.L			Scope of Chemical Science and Engineering IIB	1-0-0	3	A	【Chemical Science and Engineering】(CAP.I402)
		ENR.H488.L		□	Introduction to the Frontiers of Environmental Chemistry I	1-0-0	1,3	B	【Chemical Science and Engineering】(CAP.I481)
		ENR.H489.L		□	Introduction to the Frontiers of Environmental Chemistry II	1-0-0	1,3	B	【Chemical Science and Engineering】(CAP.I482)
		ENR.H490.L			Frontiers of Chemical Science and Engineering	1-0-0	3	B	【Chemical Science and Engineering】(CAP.T423)
		ENR.H491.L		★ □	Introduction to Polymer Physical Chemistry	1-0-0	3	B	【Chemical Science and Engineering】(CAP.P433)
		ENR.H492.L		★	Advanced Course of Step-growth Polymerization	1-0-0	3,4	B	【Chemical Science and Engineering】(CAP.P413)
		ENR.H493.L		★	Advanced Polymer Assembly	1-0-0	3,4	B	【Chemical Science and Engineering】(CAP.P414)
		ENR.H496.L			Frontiers of Chemical Science and Engineering II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.T424)
		Chemical Science and Engineering Course Track 500 Level							
		ENR.E521.L		★ □	Advanced Chemistry of Transition Metal Complexes I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A561)
		ENR.E522.L		★ □	Advanced Chemistry of Transition Metal Complexes II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A562)

		ENR.E541.L		★ □	Advanced Polymer Reactions	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.P511)
		ENR.E542.L		□	Advanced Polymer Processing	1-0-0	3,4,5	B	【Chemical Science and Engineering】(CAP.P581)
		ENR.E543.L		□	Advanced Polymer Science I	1-0-0	1,3,5	B	【Chemical Science and Engineering】(CAP.P582)
		ENR.E544.L		□	Advanced Polymer Science II	1-0-0	1,3,5	B	【Chemical Science and Engineering】(CAP.P583)
		ENR.E551.L		★	Chemical Engineering in Global Business	1-0-0	1,2,3,5	B	【Chemical Science and Engineering】(CAP.C521)
		ENR.E552.L		★ □	Advanced Chemical Equipment Design	2-0-0	3,5	B	【Chemical Science and Engineering】(CAP.C531)
		ENR.E553.L		★ □	Plasma Chemistry and Plasma Processing	1-0-0	3,4	B	【Chemical Science and Engineering】(CAP.C533)
		ENR.H527.L		★ □	Advanced Supercritical Fluid Process	1-0-0	3,4	B	【Chemical Science and Engineering】(CAP.C534)
		ENR.E554.L		★ □	Fine Particle Engineering	1-0-0	1,3,4,5	B	【Chemical Science and Engineering】(CAP.C542)
		ENR.H528.L		★ □	Tribology and Surface Engineering	1-0-0	1,3,5	B	【Chemical Science and Engineering】(CAP.C543)
		ENR.E561.L		★ □	Advanced Catalytic Reactions I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.T531)
		ENR.E562.L		★ □	Advanced Catalytic Reactions II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.T532)
		ENR.E571.L		★ □	Advanced Strategic Organic Synthesis	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I533)
		ENR.E572.L		★ □	Advanced Material Cycle Analysis	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.I536)
		ENR.E573.L		★ □	Systematic Material Design Methodology	1-0-0	4,5	B	【Chemical Science and Engineering】

									(CAP.I537)
		ENR.H501.L		★ □	Advanced Chemical Materials for Energy Issues I	1-0-0	3,4,5	B	
		ENR.H502.L		★ □	Advanced Chemical Materials for Energy Issues II	1-0-0	3,4,5	B	
		ENR.H503.L		★ □	Advanced Polymer Design for Energy Materials	1-0-0	3,4,5	B	
		ENR.H523.L		★ □	Advanced Molecular Design for Organic Synthesis I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A521)
		ENR.H524.L		★ □	Advanced Molecular Design for Organic Synthesis II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A522)
		ENR.H525.L		★ □	Advanced Polymer Structures	1-0-0	3,4,5	B	【Chemical Science and Engineering】(CAP.P522)
		ENR.H526.L		★ □	Quantum Chemical Calculations for Polymer Chemistry	1-0-0	3,4,5	B	【Chemical Science and Engineering】(CAP.P523)

Note：

• ◎：Required course, ○：Restricted elective, O：odd academic years, E：even academic years, ★：Classes in English

• □：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 ENR.D400.R): A (Interdisciplinary Scientific Principles of Energy Courses (electively required)), B (Interdisciplinary Scientific Principles of Energy Course (selective)), H (Chemical Science and Engineering Courses), I (Chemistry Courses), J (Materials Science and Engineering Courses), K (Mechanical EngineeringCourses), L (Electrical and Electronic Engineering Courses), Z (Research Seminars) The character “R” succeeding the course number represents that the course is electively required (A), elective (L), and required (R), respectively.

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: You will be able to delineate your career plan clearly and recognize the skills necessary to materialize that plan, taking into account its relation to society

C1M: You will be able to understand academic integrity, utilize your own expertise for 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 Energy 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	ENR.B502.L			Energy innovation co-creative project	0-0-1	C1M	A,C,E	
	ENR.B503			Energy Engineering Internship A	0-0-1	C1M	C,D,E	Course outside the standard curriculum
	ENR.B504			Energy Engineering Internship B	0-0-2	C1M	C,D,E	Course outside the standard curriculum
	ENR.J409.L			Introduction to Intellectual Property System	2-0-0	C0M C1M	B,C	
	CHM.A461			Presentation Exercises in Chemistry	0-1-0	C0M	C,E	Available only to students belonging to the Department of Chemistry
	CHM.A462			Introductory Exercises in Chemistry	0-1-0	C1M	C,E	Available only to students belonging to the Department of Chemistry
	MEC.R431			Off-campus Project M1c	0-0-1	C1M	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R432			Off-campus Project M2c	0-0-2	C1M	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S531			Overseas Research Project M1c	0-0-1	C1M	E	Available only to students belonging to

								the Department of Mechanical Engineering
	MEC.S532			Overseas Research Project M2c	0-0-2	C1M	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S533			Overseas Research Project M3c	0-0-3	C1M	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S534			Overseas Research Project M4c	0-0-4	C1M	E	Available only to students belonging to the Department of Mechanical Engineering
	EEE.R561			Internship (Master Course) A	0-0-1	C1M	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R562			Internship (Master Course) B	0-0-2	C1M	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R563			Internship (Master Course) C	0-0-4	C1M	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R564			Internship (Master Course) D	0-0-6	C1M	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.G401			Utilization of Intelligent Information Resources and Patents	1-0-0	C1M	B,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	MAT.A460			Off-campus Project in Materials	0-0-1	C1M	D	Available only to

				Science and Engineering A1				students belonging to the Department of Materials Science and Engineering
	MAT.A461			Off-campus Project in Materials Science and Engineering A2	0-0-2	C1M	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A462		★	Off-campus Project in Materials Science and Engineering B1	0-0-1	C1M	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A463		★	Off-campus Project in Materials Science and Engineering B2	0-0-2	C1M	D	Available only to students belonging to the Department of Materials Science and Engineering
	CAP.E521			Scientific Ethics	1-0-0	C0M	D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E422			Presentation Practice	0-1-0	C1M	E	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E411			Advanced Internship in Chemical Science and Engineering I	0-0-1	C1M	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E412			Advanced Internship in Chemical Science and Engineering II	0-0-2	C1M	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	ENR.B511.L		★	TSE Energy Off-Campus Project S A	0-0-1	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only

	ENR.B512.L		★	TSE Energy Off-Campus Project S B	0-0-1	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B513.L		★	TSE Energy Off-Campus Project S C	0-0-1	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B514.L		★	TSE Energy Off-Campus Project S D	0-0-1	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B515.L		★	TSE Energy Off-Campus Project L A	0-0-2	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B516.L		★	TSE Energy Off-Campus Project L B	0-0-2	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B517.L		★	TSE Energy Off-Campus Project L C	0-0-2	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B518.L		★	TSE Energy Off-Campus Project L D	0-0-2	C1M	B,C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B519.L		★	TSE Energy International Workshop A	0-0-1	C1M	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B520.L		★	TSE Energy International Workshop B	0-0-1	C1M	C,E	For students affiliated with the Department of Transdisciplinary Science and

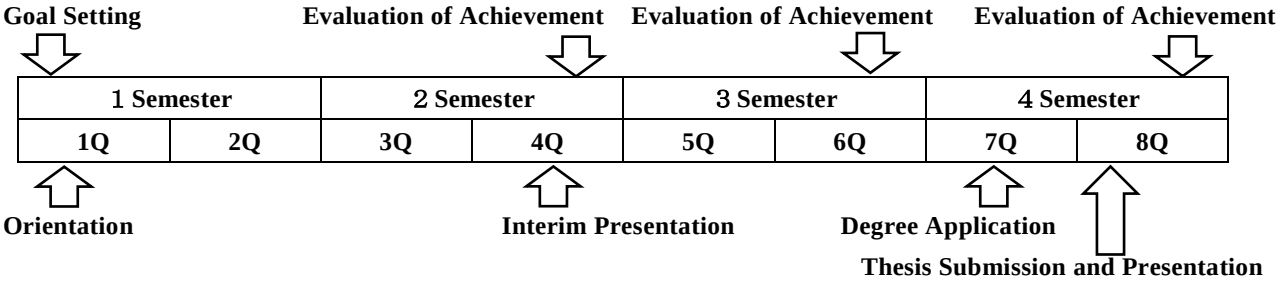
								Engineering only
	ENR.B521.L		★	TSE Energy International Workshop C	0-0-1	C1M	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B522.L		★	TSE Energy International Workshop D	0-0-1	C1M	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only

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

Research Related to the Completion of Master Thesis

During the master's thesis research the student acquires the abilities to identify and to solve new issues as well as develope technical communication skills by communicating the research results. The typical time lineof the master's thesis research is shown below. The learning objectives and research results will be evaluated by the candidate's supervisor. The candidate will develophis or her study plan based on the goals and progress during the master's thesis research.



・Interim Presentation of Master's Thesis

To understand background, purposes, and issues of his or her own master's thesis research, "Interim Presentation of Master's Thesis" is required.

・Screening Criteria for Master's Thesis

A master's thesis must include new knowledge contributing to the development in energy science and engineering and which is also original.

・Screening of Master's Thesis

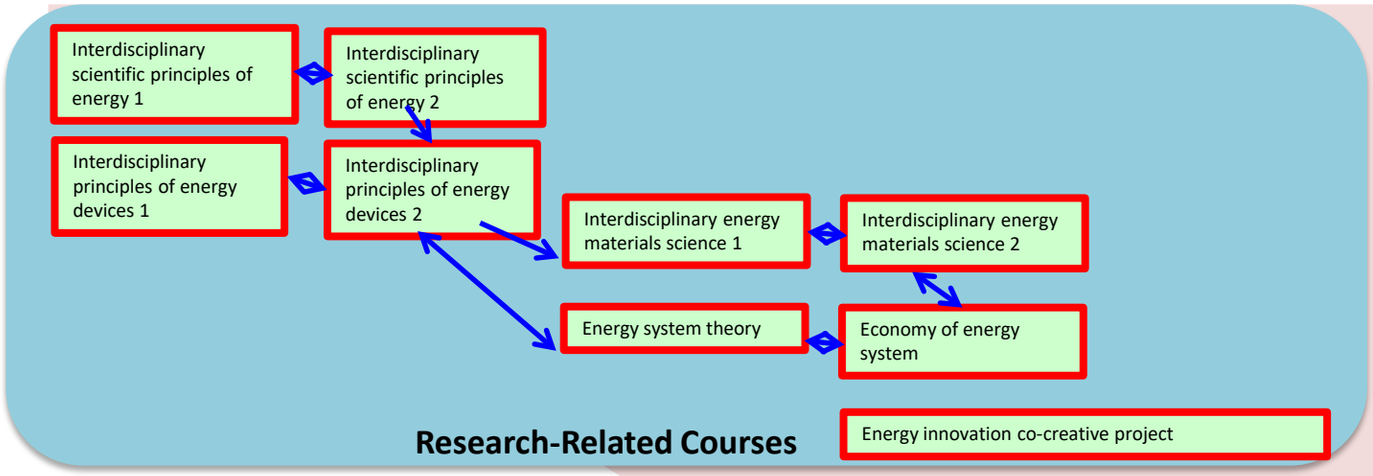
Prior to the final screening, the thesis will be reviewed by examiners. Final screening and evaluation of the thesis is based on the student's oral presentation. Oral presentation must be carried out in English or Japanese.

【Department of Chemistry, Graduate Major of Energy Science and Engineering (Master's program)】

Required courses | Effective Courses

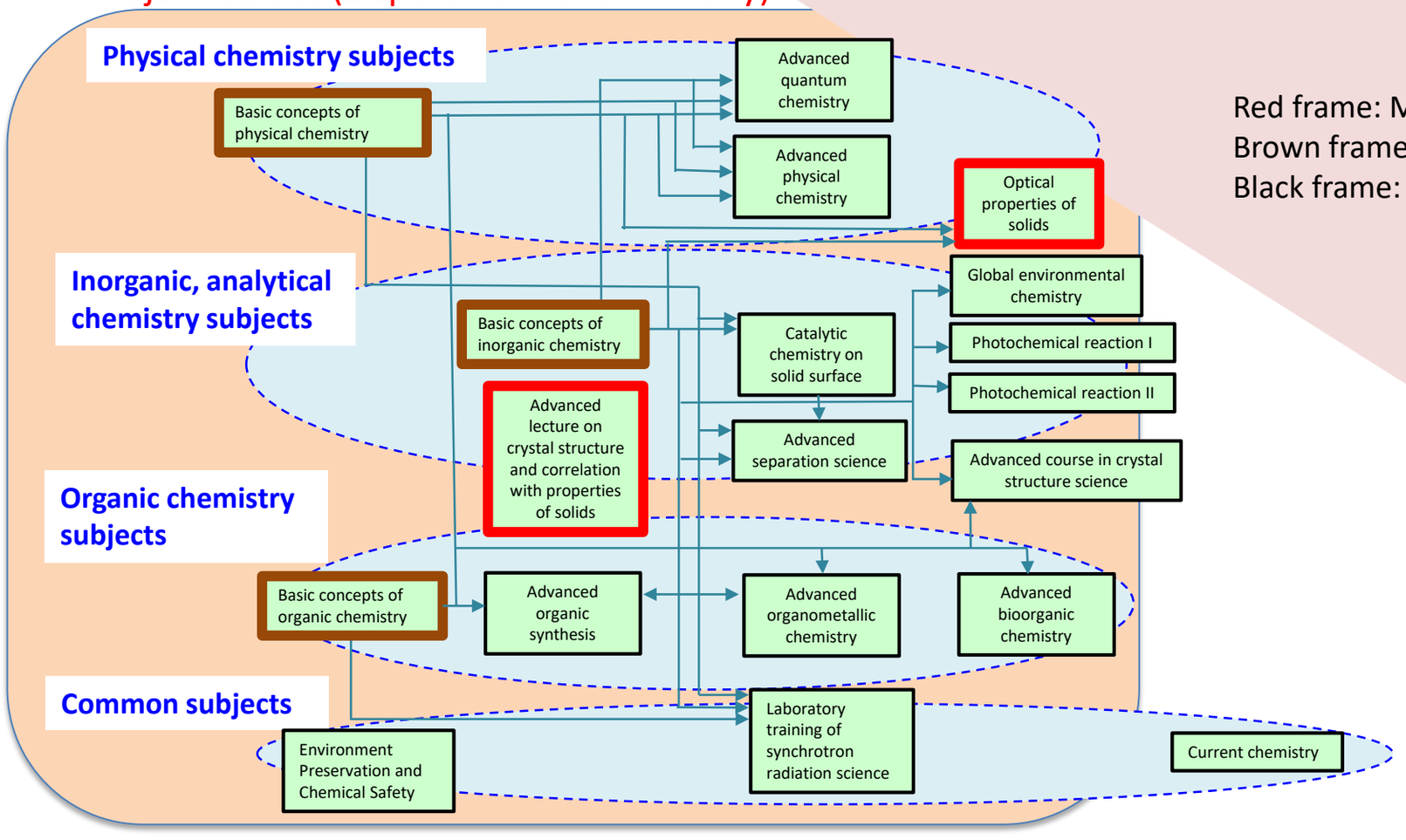
1①	1②	1③	1④	2①	2②	2③	2④

Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

Major courses (Department of Chemistry)



Red frame: Major courses
Brown frame: Common subjects in chemistry department
Black frame: Subjects of chemistry courses (recommended)

Research seminars

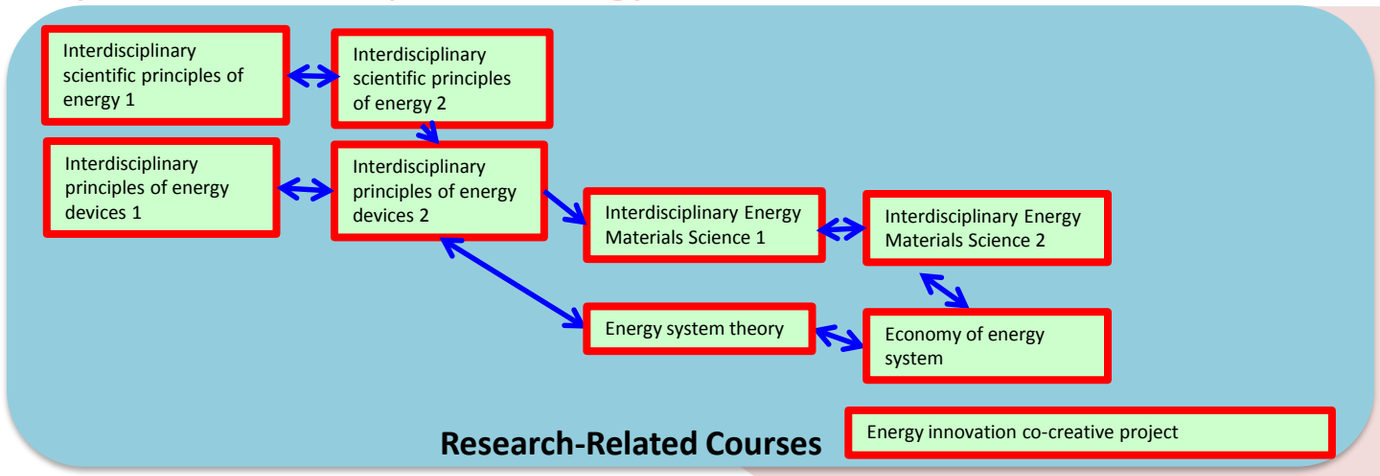
Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Department of Mechanical Engineering, Graduate Major of Energy Science and Engineering (Master's program) 】

Required Courses　Elective Courses

1①	1②	1③	1④	2①	2②	2③	2④

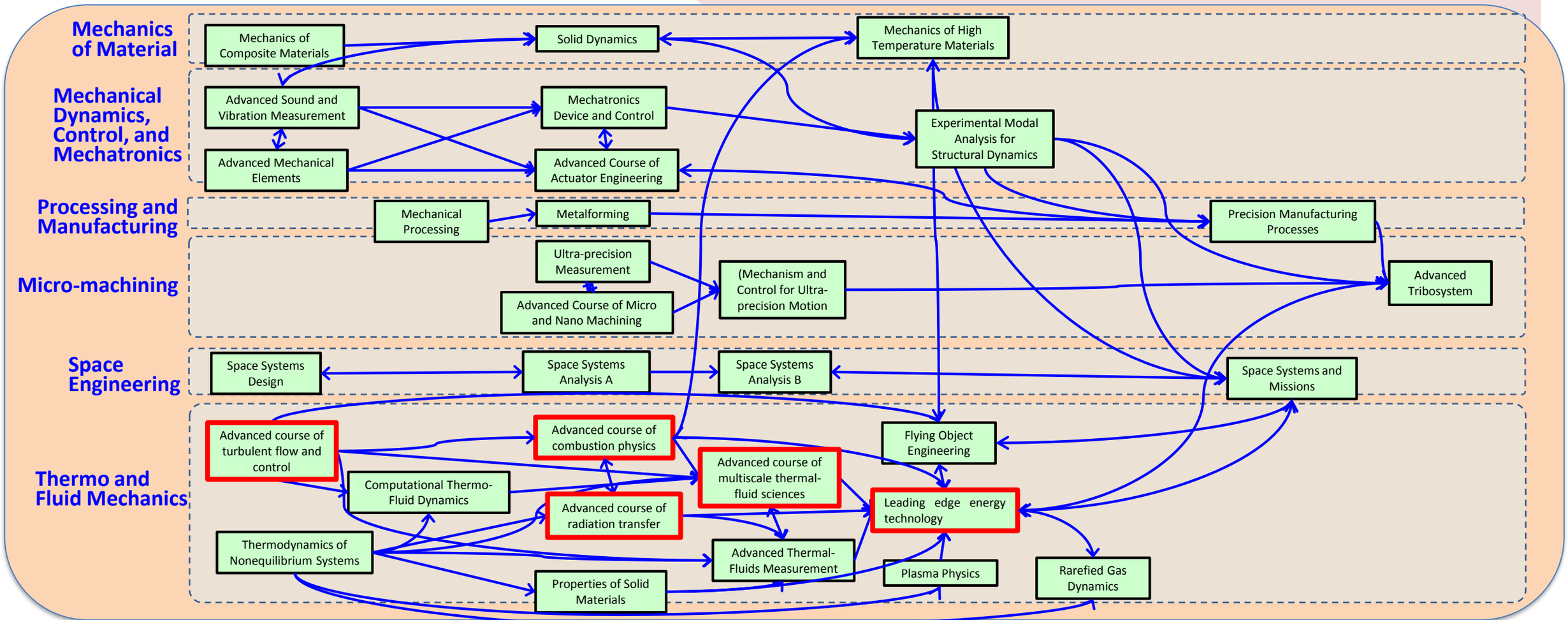
Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

Red frame: Major Courses
Black frame: Research-Related Courses

Major Courses (Department of Mechanical Engineering)



Research Seminars

Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Department of Electrical and Electronic Engineering, Major of Energy Science and Engineering (Master's program)】

Required Courses　Elective Courses

1①	1②	1③	1④	2①	2②	2③	2④

Interdisciplinary Scientific Principles of Energy Courses

Interdisciplinary scientific principles of energy 1
Interdisciplinary scientific principles of energy 2
Interdisciplinary principles of energy devices 1
Interdisciplinary principles of energy devices 2
Interdisciplinary Energy Materials Science 1
Interdisciplinary Energy Materials Science 2
Energy system theory
Economy of energy system
Energy innovation co-creative project

Research-Related Courses

Master's Thesis Research

Red frame: Major Courses
Black frame: Research-Related Courses

Major Courses (Department of Electrical and Electronic Engineering)

Common

Utilization of Intelligent Information Resources and Patents
Electrical Modeling and Simulation

Power, System

Advanced Electromagnetic Waves
Wireless Communication Engineering
Optical Communication Systems
Electric Power and Motor Drive System Analysis
Advanced Electric Power Engineering
Advanced Course of Power Electronics
Magnetic Levitation and Magnetic Suspension
Mechanical-to-electrical energy conversion
Pulsed Power Technology
Environment and Electric Energy
Plasma Engineering

Device, Materials

Advanced Power Semiconductor Devices
VLSI Technology I
VLSI Technology II
Bipolar Transistors and Compound Semiconductor Devices
Semiconductor Physics
Advanced functional electron devices
Magnetism and Spintronics
Nano-Structure Devices
Introduction to Photovoltaics
Fundamentals of Electronic Materials
Dielectric Property and Organic Devices
Teraheltz Devices and Systems

Research Seminars

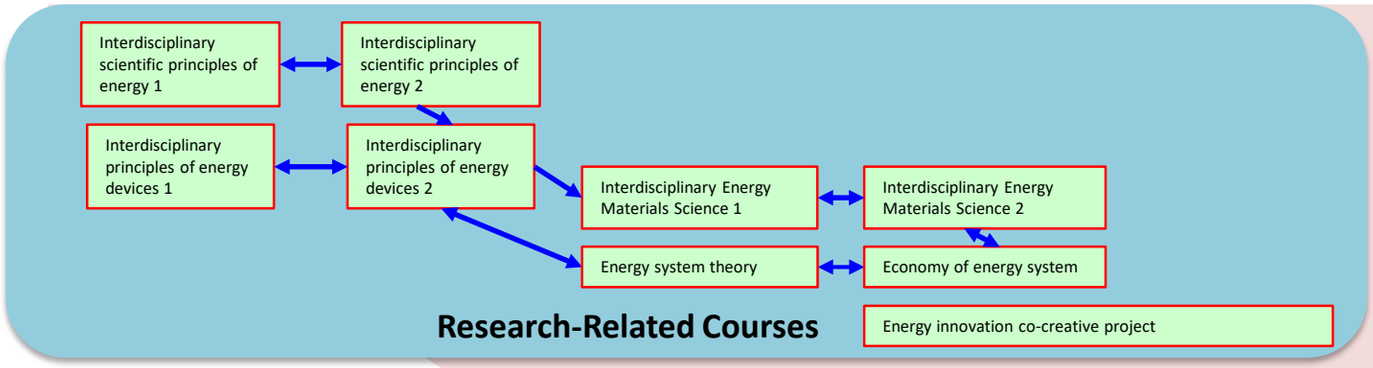
Seminar in energy science S1
Seminar in energy science F1
Seminar in energy science S2
Seminar in energy science F2

【Department of Materials Science and Engineering, Major of Energy Science and Engineering (Master's program)】

Required Courses　Elective Courses

1①	1②	1③	1④	2①	2②	2③	2④

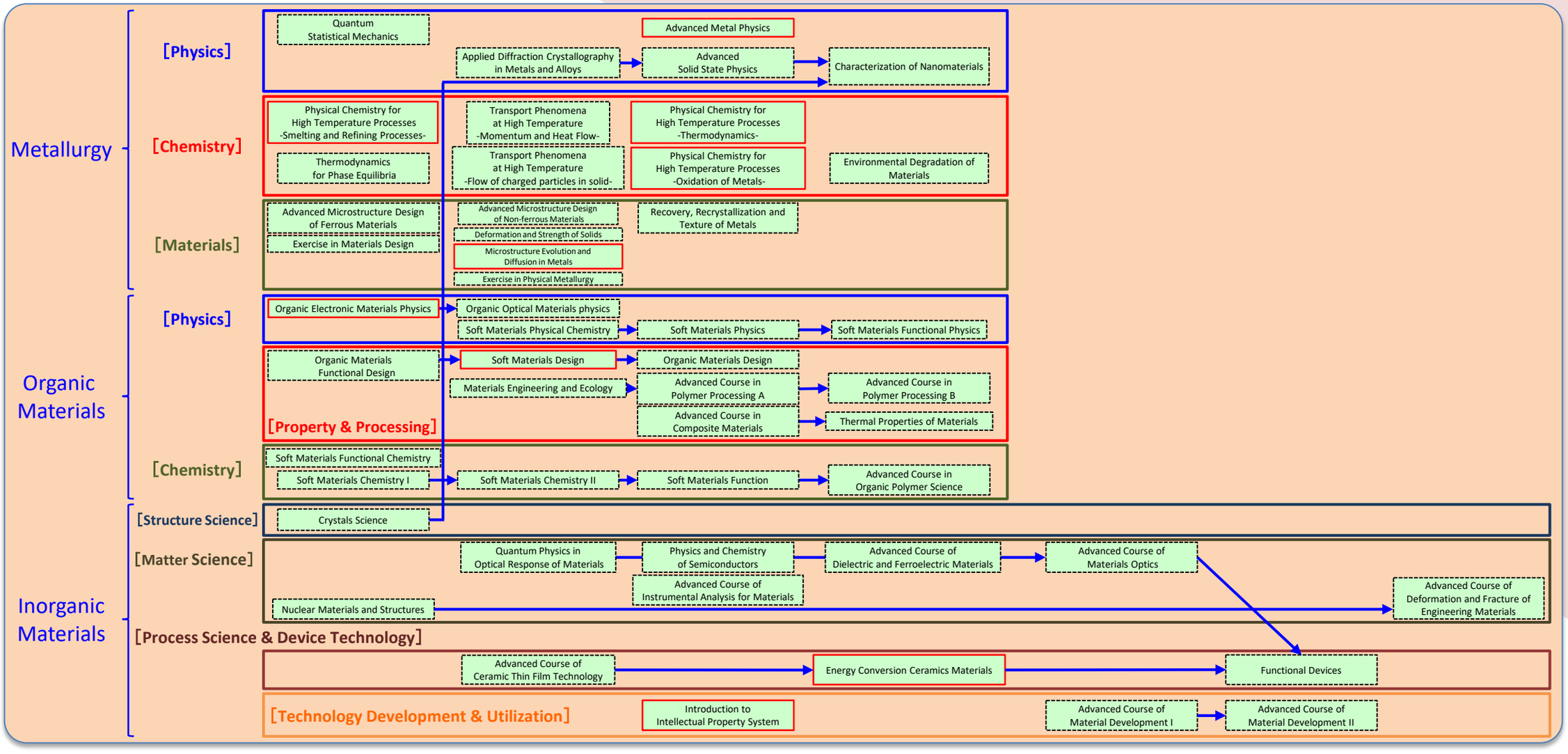
Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

Red frame: Major Courses
Black frame: Research-Related Courses

Major Courses (Department of Materials Science and Engineering)



Research Seminars

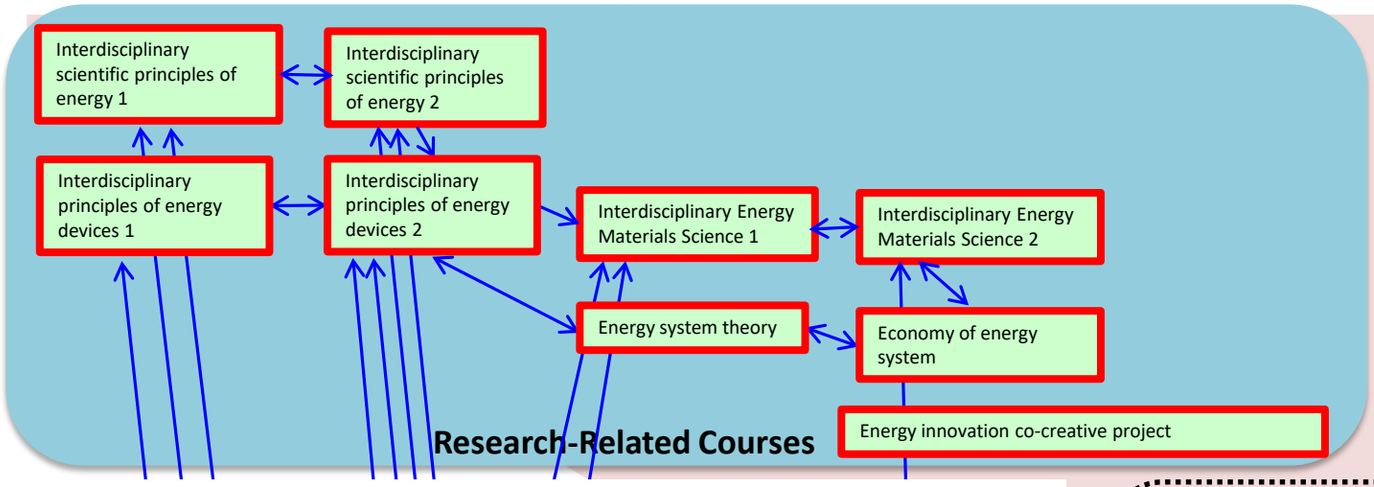
Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Department of Chemical Science and Engineering, Graduate Major of Energy Science and Engineering (Master's program) 】

Required Courses　Elective Courses

1①	1②	1③	1④	2①	2②	2③	2④

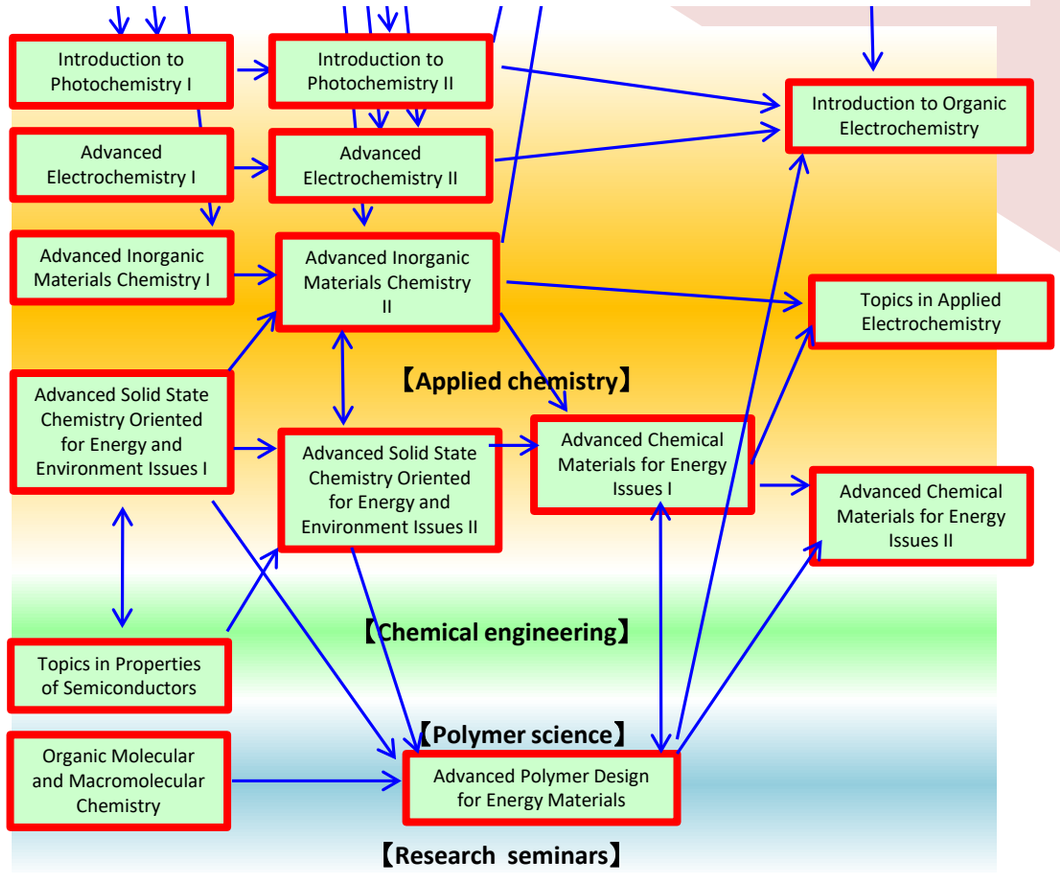
Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

Red frame: Major Courses
Black frame: Research-Related Courses

Major Courses (Department of Chemical Science and Engineering)



Applied chemistry　1①～2④

Environmental Chemistry	Advanced Organic Materials Chemistry	Advanced Strategic Organic Synthesis	Advanced Solid State Chemistry I	Advanced Organo-metallic Chemistry and Catalysis
Advanced Coordi-nation Chemistry	Advanced Geochemistry	Nanotechnology and Nanoscience	Advanced Solid State Chemistry II	Advanced Electrochemistry I
Advanced Organic Synthesis I	Advanced Instru-mental Analysis	Advanced Supra-molecular Science	Advanced Bioinorganic Chemistry I	Advanced Electrochemistry II
Advanced Organic Synthesis II	Catalysis for the Environmental Issues	Advanced Catalytic Chemistry	Advanced Bioinorganic Chemistry II	Advanced Chemistry of Transition Metal Complexes II

Chemical engineering　1①～2④

Introduction to Chemical Engineering (Basics)	Chemical Engineering in Global Business	Advanced Chemical Reaction Engineering	Advanced Supercritical Fluid Process	Transport Phenomena and Operation
Introduction to Chemical Engineering (Unit Operation)	Systematic Material Design Methodology	Process Dynamics and Control	Advanced Chemical Equipment Design	Advanced Bioprocess Engineering
Advanced Energy Transfer Operation	Process Systems Engineering	Phase Equilibrium Analysis in Chemical Engineering	Physico-Chemical Property Analysis in Chemical Engineering	Computational Fluid Dynamics

Polymer science ①～2④

Introduction to Polymer Science	Advanced Polymer Synthesis I	Introduction to Polymer Physical Chemistry		Advanced Polymer Processing
Introduction to Polymer Chemistry	Advanced Polymer Synthesis II		Advanced Polymer Structures	Advanced Polymer Reactions
Introduction to Polymer Physical Properties I	Advanced Polymer Properties I		Advanced Course of Step-growth Polymerization	Advanced Polymer Science I
Introduction to Polymer Physical Properties II	Advanced Polymer Properties II		Advanced Polymer Assembly	Advanced Polymer Science II

Research seminars　1①～2④

Environment Preservation and Chemical Safety I	Environment Preservation and Chemical Safety II	Advanced Internship in Chemical Science and Engineering	Presentation Practice	Scientific Ethics

Research Seminars

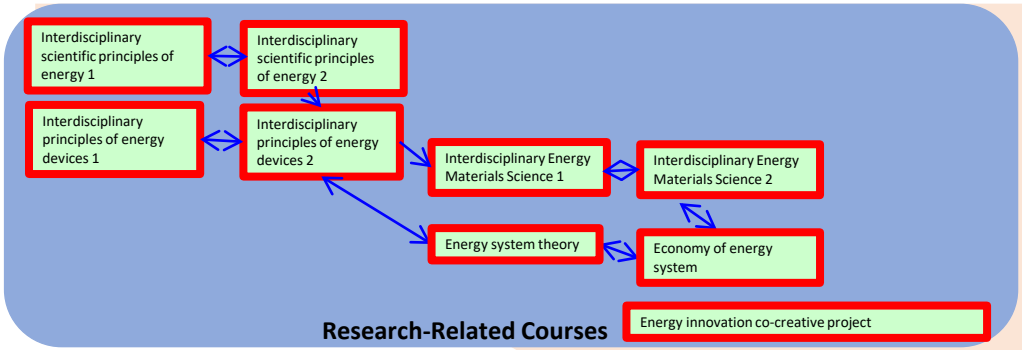
Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Department of Transdisciplinary Science and Engineering, Major of Energy Science and Engineering (Master's program)】

Required Courses　Elective Courses

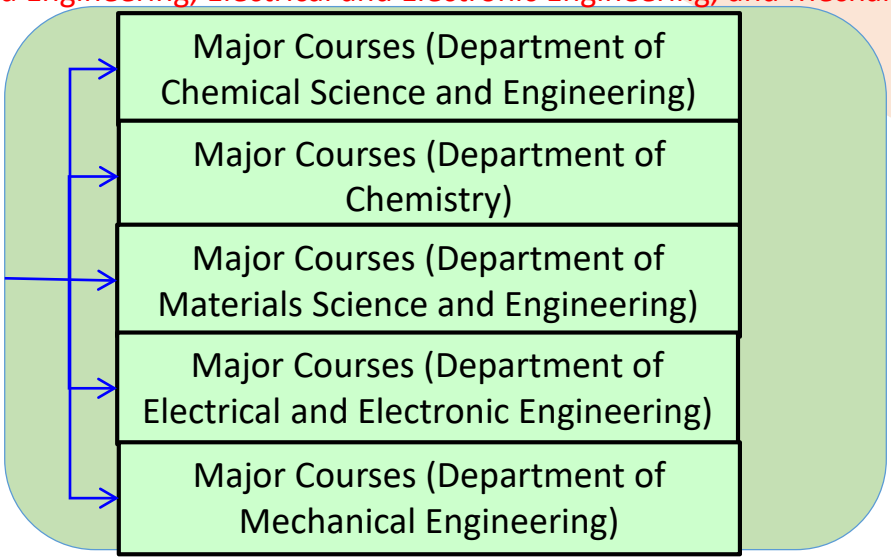
1①	1②	1③	1④	2①	2②	2③	2④

Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

Major Courses（either one or more from Chemical Science and Engineering, Chemistry, Materials Science and Engineering, Electrical and Electronic Engineering, and Mechanical Engineering）



Research Seminars

Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Doctoral Degree Program】

1. Outline

To integrate and reorganize the inter-relationships in conventional energy-related disciplines, which developed with differentiation and deepening, creation of a novel discipline, “Interdisciplinary Scientific Principles of Energy”, and development of human resources mastering this discipline have been strongly required for overlooking of energy issues and effectively utilization of energy-related disciplines.

In the Doctoral Degree Program, the Energy Science and Engineering Major aims at nurturing an independent research scientist and engineer with advanced expert knowledge in the field of energy science and engineering. Students in this major are expected to pursue the principles of energy-related phenomena by using knowledge in the field of energy science and engineering and to lead a cutting-edge research and development in consideration of societal responsibilities and ethics as well as acquire competence as a global leader who contributes to create a sustainable society.

2. Competencies Developed

The students are expected to acquire,

- Abilities to identify, to investigate, and to solve new issues by using knowledge in the field of energy science and engineering.
- Ability to conduct innovative research and development in an ethical manner.
- Management and technical communication skills by integrating energy-related findings from the viewpoint as an expert of energy-related discipline.
- Competence as a global leader in the energy-related fields.

3. Learning Goals

Students will learn,

A) Advanced expert knowledge in the field of energy science and engineering

Students will gain expert knowledge in greater depth than the master course and to have the ability to apply the knowledge to energy-related phenomena through the doctoral coursework Core Courses and Research Seminars.

B) Ability to solve problems

Students are requested to acquire the ability to find out research problems and solve them by integrating their original discipline such as in chemistry, applied chemistry, material science, mechanical engineering, energy based economics or electrical engineering with other energy-related disciplines.

C) Ability to create solutions

Students are requested to acquire the ability to create solutions by freely utilizing their original discipline and other energy-related disciplines.

D) Competency as a global leader in energy research

Students will acquire the abilities to evaluate their research perspectives and applications from the global point of view, establishing a human network, and lead frontier energy science and engineering, by integrating energy-related disciplines.

E) Communication skills

Develop technical communication skills through discussions with expert scientists in the domestic and international community and presenting their own research results.

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 Energy Science and Engineering curriculum,
   - 12 credits acquired from Research Seminars;
   - 18 credits or more, acquired from the subject in 600-level courses of this major;
   - a minimum of 6 credits acquired from Major Courses; and
   - a minimum of 6 credits acquired from Liberal Arts and Basic Science Courses
     (2 credits from Humanities and Social Sciences Courses, and 4 credits from Career Development Courses).
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 Energy 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 Energy Science S3 Seminar in Energy Science F3 Seminar in Energy Science S4 Seminar in Energy Science F4 Seminar in Energy Science S5 Seminar in Energy Science F5 A total of 12 credits, 2 credits each from the above courses.		18 credits	A,B,C,D,E	
	Research-related courses				C,D,E	
	Major courses		6 credits		A,B,C,D	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Energy 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 Energy Science and Engineering

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	600 level	ENR.Z691.R	◎		Seminar in energy science S3	0-0-2	2,3,4,5	A,B,C	
		ENR.Z692.R	◎		Seminar in energy science F3	0-0-2	2,3,4,5	A,B,C	
		ENR.Z693.R	◎		Seminar in energy science S4	0-0-2	2,3,4,5	A,B,C	
		ENR.Z694.R	◎		Seminar in energy science F4	0-0-2	2,3,4,5	A,B,C	
		ENR.Z695.R	◎		Seminar in energy science S5	0-0-2	2,3,4,5	A,B,C	
		ENR.Z696.R	◎		Seminar in energy science F5	0-0-2	2,3,4,5	A,B,C	
Major courses	600 level	ENR.E601.L			Practical Presentation A	0-0-1	2,3	A,B,C,E	
		ENR.E602.L			Practical Presentation B	0-0-1	2,3	A,B,C,E	
		ENR.E603.L			Practical Presentation C	0-0-1	2,3	A,B,C,E	
		ENR.E604.L		★	International scientific presentation A	0-0-1	2,3	A,B,C,D,E	
		ENR.E605.L		★	International scientific presentation B	0-0-1	2,3	A,B,C,D,E	
		ENR.E606.L		★	International scientific presentation C	0-0-1	2,3	A,B,C,D,E	
		ENR.E607.L			Practical research in energy science A	0-0-1	3,4	A,B,C	
		ENR.E608.L			Practical research in energy science B	0-0-1	3,4	A,B,C	
		ENR.E613.L			Practical research in energy science C	0-0-1	2,3,4	A,B,C	
		ENR.E614.L			Practical research in energy science D	0-0-1	2,3,4	A,B,C	
		ENR.E609.L			Academic teaching	0-1-0	2,3	D,E	

		ENR.E610.L		★ □	Academic Writing A	1-0-0	2,4	A,C,E	
		ENR.E611.L		★ □	Academic Writing B	1-0-0	1,2,4	A,C,E	
		ENR.E612.L		★	International energy project	0-0-2	1,2,4,5	C,D,E	
		ENR.E615.L			Special Experiment and Practice for Working Adults in Energy Science and Engineering 1	0-0-1	3,4,5	C	
		ENR. E616.L			Special Experiment and Practice for Working Adults in Energy Science and Engineering 2	0-0-1	3,4,5	C	
		ENR.E617.L			Special Experiment and Practice for Working Adults in Energy Science and Engineering 3	0-0-1	3,4,5	C	
		ENR.B601.L		★	Advanced Topics on Fourier Transform and Some of Its Applications	1-0-0	3	B	【School of Engineering】(XEG.S606)
		ENR.L601.L		★	Advanced Topics in Digital VLSI Design	1-0-0	3,4	A,B	【School of Engineering】(XEG.S605)
		ENR.P601.L		★	Energy Science and Engineering Project	0-0-2	2,4	A,E	
		ENR.R602.L		★	Energy Science and Engineering Off-Campus Project D1c	0-0-2	2,4,5	A,C,E	
		ENR.R603.L		★	Energy Science and Engineering Off-Campus Project D2c	0-0-4	2,4,5	A,C,E	
		ENR.K601.L		★	Special Lecture in Mechanical Engineering I	1-0-0	1,3	B	【Mechanical Engineering】(MEC.N631)
		ENR.K602.L		★	Special Lecture in Mechanical Engineering II	1-0-0	1,3	B	【Mechanical Engineering】(MEC.N632)
		ENR.K603.L		★	Special Lecture in Mechanical Engineering III	1-0-0	1,3	B	【Mechanical Engineering】(MEC.N633)
		ENR.K604.L		★	Special Lecture in Mechanical Engineering IV	1-0-0	1,3	B	【Mechanical Engineering】(MEC.N634)

Note：

• ◎：Required course, ★：Classes in English

• □：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 ENR.D600.R): E (Major Courses), Z (Research Seminars). The character “R” succeeding the course number represents that the course is elective (L) and required (R), respectively.

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 define your own career plan and train yourself to acquire the skills required for attaining your goals in academia
- A1D: You will be able to ascertain the true nature of phenomena, master the secret of learning, and lead the vanguard of a new academic discipline or research area
- A2D: You will be able to understand the position of academia in society as well as the notion of responsible conduct of research, and adequately explain academic progress to members of society, who are our stakeholders
- A3D: With the understanding of the social roles and responsibilities of researchers, you will be able to nurture next-generation experts in educational institutions, instilling in them an interest in academia 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 plot your own career plan and train yourself to acquire the skills required for attaining your goals in industry, etc.
- P1D: You will be able to precisely grasp the needs of society and detect its problems, comprehend relevant laws, regulations, or guidelines for responsible conduct of research, and lead 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 society
- P3D: With the understanding of the social roles and responsibilities of engineers, you will be able to nurture next-generation experts through the project, enabling them to help drive future development of society and industry

Table D3-1. Courses of the Graduate Major in Energy 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	ENR.E607.L			Practical research in energy science A	0-0-1	A1D A2D	A,B,C	
	ENR.E608.L			Practical research in energy science B	0-0-1	A1D A2D	A,B,C	
	ENR.E604.L		★	International scientific presentation A	0-0-1	A1D	A,B,C,D,E	
	ENR.E605.L		★	International scientific presentation B	0-0-1	A1D	A,B,C,D,E	
	ENR.E606.L		★	International scientific presentation C	0-0-1	A1D	A,B,C,D,E	
	ENR.E609.L			Academic teaching	0-1-0	A3D	D,E	
	ENR.E612.L		★	International energy project	0-0-2	A1D A2D	C,D,E	
	ENR.P601.L		★	Energy Science and Engineering Project	0-0-2	A1D	A,E	
	ENR.R602.L		★	Energy Science and Engineering Off-Campus Project D1c	0-0-2	A1D	A,C,E	
	ENR.R603.L		★	Energy Science and Engineering Off-Campus Project D2c	0-0-4	A1D	A,C,E	
	CHM.A661		★	Basic Exercises in Global Presentation	0-1-0	A1D A2D	C	Available only to students belonging to the Department of Chemistry
	CHM.A662		★	Advanced Exercises in Global Presentation	0-1-0	A2D A3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A651			Laboratory Training of Advanced Chemistry I	0-0-1	A2D A3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A652			Laboratory Training of Advanced Chemistry II	0-0-1	A2D A3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A653			Laboratory Training of Advanced Chemistry III	0-0-1	A2D A3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A654			Laboratory Training of Advanced Chemistry IV	0-0-1	A2D A3D	C	Available only to students belonging to the Department of Chemistry

	MEC.T631			Teaching Practice in Mechanical Engineering	0-0-2	A2D A3D	D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R631			Off Campus Project D1c	0-0-1	A2D A3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R632			Off Campus Project D2c	0-0-2	A2D A3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R633			Off Campus Project D3c	0-0-3	A2D A3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R634			Off Campus Project D4c	0-0-4	A2D A3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R635			Off Campus Project D5c	0-0-5	A2D A3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R636			Off Campus Project D6c	0-0-6	A2D A3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S631			Overseas Research Project D1c	0-0-1	A2D A3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S632			Overseas Research Project D2c	0-0-2	A2D A3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S633			Overseas Research Project D3c	0-0-3	A2D A3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S634			Overseas Research Project D4c	0-0-4	A2D A3D	E	Available only to students belonging to the Department of Mechanical Engineering

	MEC.S635			Overseas Research Project D5c	0-0-5	A2D A3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S636			Overseas Research Project D6c	0-0-6	A2D A3D	E	Available only to students belonging to the Department of Mechanical Engineering
	EEE.G601		★	Teaching Skills in English for Doctoral Course Students	0-1-0	A1D	D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R611		★	Doctor Course Colloquium	0-1-0	A2D A3D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R621		★	International Presentations	0-1-0	A2D A3D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R601			Training on Teaching Technique	0-1-0	A1D A2D A3D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R651		★	Study Abroad (Doctor Course) A	0-0-1	A1D A2D A3D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R652		★	Study Abroad (Doctor Course) B	0-0-2	A1D A2D A3D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R653		★	Study Abroad (Doctor Course) C	0-0-4	A1D A2D A3D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R654		★	Study Abroad (Doctor Course) D	0-0-6	A1D	B,D,E	Available only to students

						A2D A3D		belonging to the Department of Electrical and Electronic Engineering
	EEE.R661			Internship (Doctor Course) A	0-0-1	A1D A2D A3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R662			Internship (Doctor Course) B	0-0-2	A1D A2D A3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R663			Internship (Doctor Course) C	0-0-4	A1D A2D A3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R664			Internship (Doctor Course) D	0-0-6	A1D A2D A3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	MAT.A661			Materials Off-campus Project 1	0-0-1	A1D, A2D, A3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A662			Materials Off-campus Project 2	0-0-2	A1D, A2D, A3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A663			Materials Off-campus Project 3	0-0-4	A1D, A2D, A3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A664			Materials Off-campus Project 4	0-0-6	A1D, A2D, A3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	CAP.E631			Chemical Science and Engineering Off-Campus Project 1	0-0-1	A1D, A2D, A3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering

	CAP.E632			Chemical Science and Engineering Off-Campus Project 2	0-0-2	A1D, A2D, A3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E633			Chemical Science and Engineering Off-Campus Project 3	0-0-4	A1D, A2D, A3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E634			Chemical Science and Engineering Off-Campus Project 4	0-0-6	A1D, A2D, A3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
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 Energy 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	ENR.E607.L			Practical research in energy science A	0-0-1	P1D P2D	A,B,C	
	ENR.E608.L			Practical research in energy science B	0-0-1	P1D P2D	A,B,C	
	ENR.E604.L		★	International scientific presentation A	0-0-1	P1D	A,B,C,D,E	
	ENR.E605.L		★	International scientific presentation B	0-0-1	P1D	A,B,C,D,E	
	ENR.E606.L		★	International scientific presentation C	0-0-1	P1D	A,B,C,D,E	
	ENR.E612.L		★	International energy project	0-0-2	P1D P2D	C,D,E	
	ENR.P601.L		★	Energy Science and Engineering Project	0-0-2	P1D	A,E	
	ENR.R602.L		★	Energy Science and Engineering Off-Campus Project D1c	0-0-2	P1D	A,C,E	
	ENR.R603.L		★	Energy Science and Engineering Off-Campus Project D2c	0-0-4	P1D	A,C,E	
	CHM.A661		★	Basic Exercises in Global Presentation	0-1-0	P1D P2D	C	Available only to students belonging to the Department of Chemistry
	CHM.A662		★	Advanced Exercises in Global Presentation	0-1-0	P2D P3D	C	Available only to students belonging to the

								Department of Chemistry
	CHM.A651			Laboratory Training of Advanced Chemistry I	0-0-1	P2D P3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A652			Laboratory Training of Advanced Chemistry II	0-0-1	P2D P3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A653			Laboratory Training of Advanced Chemistry III	0-0-1	P2D P3D	C	Available only to students belonging to the Department of Chemistry
	CHM.A654			Laboratory Training of Advanced Chemistry IV	0-0-1	P2D P3D	C	Available only to students belonging to the Department of Chemistry
	MEC.R631			Off Campus Project D1c	0-0-1	P2D P3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R632			Off Campus Project D2c	0-0-2	P2D P3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R633			Off Campus Project D3c	0-0-3	P2D P3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R634			Off Campus Project D4c	0-0-4	P2D P3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R635			Off Campus Project D5c	0-0-5	P2D P3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R636			Off Campus Project D6c	0-0-6	P2D P3D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S631			Overseas Research Project D1c	0-0-1	P2D P3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S632			Overseas Research Project D2c	0-0-2	P2D P3D	E	Available only to students belonging to the Department of Mechanical

								Engineering
	MEC.S633			Overseas Research Project D3c	0-0-3	P2D P3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S634			Overseas Research Project D4c	0-0-4	P2D P3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S635			Overseas Research Project D5c	0-0-5	P2D P3D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S636			Overseas Research Project D6c	0-0-6	P2D P3D	E	Available only to students belonging to the Department of Mechanical Engineering
	EEE.G601		★	Teaching Skills in English for Doctoral Course Students	0-1-0	P1D	D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R611		★	Doctor Course Colloquium	0-1-0	P2D P3D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R621		★	International Presentations	0-1-0	P1D P2D P3D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R651		★	Study Abroad (Doctor Course) A	0-0-1	P1D P2D P3D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R652		★	Study Abroad (Doctor Course) B	0-0-2	P1D P2D P3D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R653		★	Study Abroad (Doctor Course) C	0-0-4	P1D P2D	B,D,E	Available only to students belonging to the

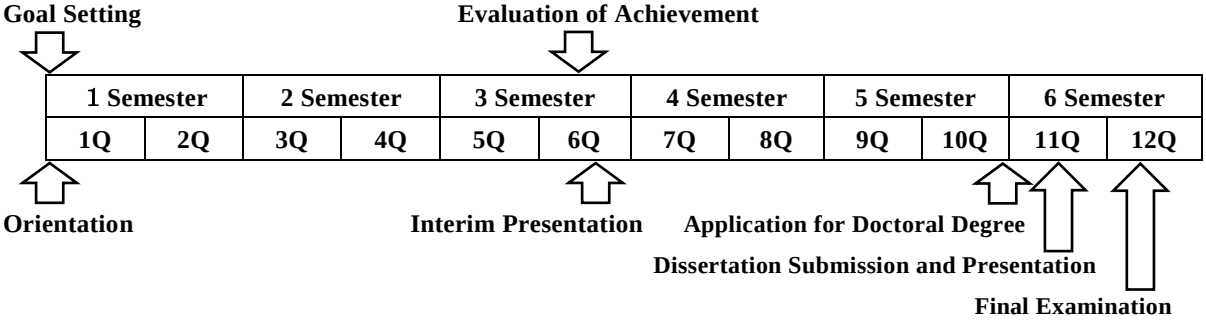
						P3D		Department of Electrical and Electronic Engineering
	EEE.R654		★	Study Abroad (Doctor Course) D	0-0-6	P1D P2D P3D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R661			Internship (Doctor Course) A	0-0-1	P1D P2D P3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R662			Internship (Doctor Course) B	0-0-2	P1D P2D P3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R663			Internship (Doctor Course) C	0-0-4	P1D P2D P3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R664			Internship (Doctor Course) D	0-0-6	P1D P2D P3D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	MAT.A661			Materials Off-campus Project 1	0-0-1	P1D, P2D, P3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A662			Materials Off-campus Project 2	0-0-2	P1D, P2D, P3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A663			Materials Off-campus Project 3	0-0-4	P1D, P2D, P3D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A664			Materials Off-campus Project 4	0-0-6	P1D, P2D, P3D	D	Available only to students belonging to the Department of Materials Science and Engineering

	CAP.E631			Chemical Science and Engineering Off-Campus Project I	0-0-1	P1D, P2D, P3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E632			Chemical Science and Engineering Off-Campus Project II	0-0-2	P1D, P2D, P3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E633			Chemical Science and Engineering Off-Campus Project III	0-0-4	P1D, P2D, P3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E634			Chemical Science and Engineering Off-Campus Project IV	0-0-6	P1D, P2D, P3D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
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, the Tokyo Tech Academy for Leadership (ToTAL) or the Tokyo Tech Academy for Convergence of Materials and Informatics (TAC-MI) 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.

Research Related to the Completion of Doctoral Thesis

The doctoral dissertation research aims to acquire the abilities to identify, to investigate, and to solve new issues by using organized knowledge in the field of energy science and engineering. In addition, improvement in English communication skill is strongly required. These abilities will be acquired through the process of goal setting,coursework,research activities,presentations and evaluation of the achievement. The typical time lineof the doctoral dissertation research is shown as follows.



・ Criteria for Doctoral Dissertation

A doctoral dissertation must be prepared that has sufficient novelty, originality, and academic value in the field of energy science and engineering. The dissertation must be written in English or Japanese.

・Doctoral Dissertation Examination

The examinationcommittee shall consist of multiple examiners who can evaluate the dissertation from an academic and a research advancement point of view. The committee can also include external examiners who belong to other universities, institutions, and companies. After the submission of doctoral dissertation, the final screening and evaluation will be carried out via oral presentation and reviewed by the dissertation examiners. Oral presentation must be carried out in English or Japanese.

【Core Courses of the Graduate Major in Energy Science and Engineering (Doctor's Program) 】

Required Courses　Elective Courses

1①	1②	1③	1④	2①	2②	2③	2④	3①	3②	3③	3④

Doctoral Dissertation Research

Humanities and Social Sciences Courses

- Independent Studies Courses 1
- Path-Breaking Liberal Arts Courses1

Career Development Courses

- Independent Studies Courses 1
- Path-Breaking Liberal Arts Courses1
- ALP Introduction
- ALP Practice I (Teaching Practice)

Major Courses

- Academic WritingA
- Academic WritingB1
- International scientific presentation A
- Practical research in energy science A
- International scientific presentation B
- Practical research in energy science B

Research Seminars

- Seminar in energy science S3
- Seminar in energy science F3
- Seminar in energy science S4
- Seminar in energy science F4
- Seminar in energy science S5
- Seminar in energy science F5