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 Department of Transdisciplinary Science and Engineering, a minimum of 4 credits from energy major courses in other departments 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 Department of Transdisciplinary Science and Engineering, a minimum of 4 credits from energy major courses in other departments that offer Graduate Major in Energy		A,B	

			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	□Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering

									Graduate Major (CAP.E401); Chemical Science and Engineering Course Track
		ENR.E492.L			Environment Preservation and Chemical Safety II	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.E402); Chemical Science and Engineering Course Track
		ENR.E493.L			Advanced Internship in Chemical Science and Engineering	0-0-1	1,2,5	B,D	Course provided by the Chemical Science and Engineering Graduate Major (CAP.E411); Chemical Science and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
		ENR.E494.L			Advanced Data Analysis	1-0-0	3,5	E or B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.E421); Chemical Science and Engineering Course Track
		ENR.E495.L			Presentation Practice	0-1-0	2,5	E or B,D	☐Recognized as an ACEEES course; Course provided by

									the Chemical Science and Engineering Graduate Major (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	□Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (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
Interdisciplinary Principles of Energy Courses 400 Level									
Major courses	**400 level**	ENR.A401.A	○	★	Interdisciplinary scientific principles of energy 1	1-0-0	3,4,5	A,C	☐Recognized as an ACEEES course
		ENR.A402.A	○	★	Interdisciplinary scientific principles of energy 2	1-0-0	3,4,5	A,C	☐Recognized as an ACEEES course
		ENR.A403.A	○	★	Interdisciplinary principles of energy devices 1	1-0-0	3,5	A,C	☐Recognized as an ACEEES course
		ENR.A404.A	○	★	Interdisciplinary principles of energy devices 2	1-0-0	3,4,5	A,C	☐Recognized as an ACEEES course
		ENR.A405.A	○	★	Interdisciplinary Energy Materials Science 1	1-0-0	3,4,5	A,C	☐Recognized as an ACEEES course
		ENR.A406.A	○	★	Interdisciplinary Energy Materials Science 2	1-0-0	3,4,5	A,C	☐Recognized as an ACEEES course
		ENR.A407.A	○		Energy system theory	1-0-0	3,4	A,C	☐Recognized as an ACEEES course
		ENR.A408.A	○		Economy of energy system	1-0-0	3,4,5	A,C	☐Recognized as an ACEEES course
		ENR.B430.L			Advanced Science and Technology in Energy and Environment	2-0-0	3,5	A,C	☐Recognized as an ACEEES course
		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	☐Recognized as an ACEEES course;

									Course provided by the Global Engineering for Development, Environment and Society Graduate Major (GEG.E404)
		ENR.B433.L		★	Project Design & Management S	0-1-1	1,2,5	B,C,E	Course provided by the Global Engineering for Development, Environment and Society Graduate Major (GEG.P451)
		ENR.B434.L		★	Project Design & Management F	0-1-1	1,2,4,5	B,C,E	Course provided by the Global Engineering for Development, Environment and Society Graduate Major (GEG.P452)
		ENR.B435.L		★	The economics and systems analysis of environment, resources and technology	1-0-0	3,4,5	A,B	☐Recognized as an ACEEES course; Course provided by the Global Engineering for Development, Environment and Society Graduate Major (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	Course provided by the Global Engineering for Development, Environment and Society Graduate Major (GEG.E421)
		Chemistry Course Track 400 Level							
		ENR.I401.L			(*)Basic Concepts of Inorganic Chemistry	2-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Chemistry

									Graduate Major (CHM.B401)
		ENR.I402.L			(*)Basic Concepts of Physical Chemistry	2-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.C401)
		ENR.I403.L			(*)Basic Concepts of Organic Chemistry	2-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.D401)
		ENR.I410.L			Optical properties of solids	2-0-0	3,4	B	
		ENR.I431.L			Laboratory Training of Synchrotron Radiation Science	0-0-1	3,5	B,D	Course provided by the Chemistry Graduate Major (CHM.A431)
		ENR.I435.L		★	Current Chemistry I	1-0-0	1,2,3	B,D	Course provided by the Chemistry Graduate Major (CHM.A435)
		ENR.I436.L		★	Current Chemistry II	1-0-0	1,2,3	B	Course provided by the Chemistry Graduate Major (CHM.A436)
		ENR.I437.L		★	Current Chemistry III	1-0-0	1,2,3	B	Course provided by the Chemistry Graduate Major (CHM.A437)
		ENR.I438.L		★	Current Chemistry IV	1-0-0	1,2,3	B	Course provided by the Chemistry Graduate Major (CHM.A438)
		ENR.I441.L			Advanced Separation Science	2-0-0	3,5	B	Course provided by the Chemistry Graduate Major (CHM.B431)
		ENR.I442.L			Catalytic Chemistry on Solid Surface	2-0-0	3	B	Course provided by the Chemistry Graduate Major (CHM.B433)

		ENR.I443.L			Advanced Course in Crystal Structure Science	2-0-0	3	B	Course provided by the Chemistry Graduate Major (CHM.B434)
		ENR.I444.L			Advanced Bioorganic Chemistry	2-0-0	3	B	Course provided by the Chemistry Graduate Major (CHM.D431)
		Chemistry Course Track 500 Level							
		ENR.I520.L			Advanced Lecture on Crystal Structure and Correlation with Properties of Solids	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.I532.L			Global Environmental Chemistry	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.B532)
		ENR.I535.L			Advanced Physical Chemistry	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.C531)
		ENR.I536.L			Advanced Quantum Chemistry	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.C532)
		ENR.I537.L			Advanced Organic Synthesis	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.D531)
		ENR.I538.L			Advanced Organometallic Chemistry	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemistry Graduate Major (CHM.D532)

		Mechanical Engineering Course Track 400 Level							
		ENR.K401.L			Mechanics of Composite Materials	1-0-0	3	A	Course provided by the Mechanical Engineering Graduate Major (MEC.C431)
		ENR.K402.L			Solid Dynamics	1-0-0	3,5	A	Course provided by the Mechanical Engineering Graduate Major (MEC.C433)
		ENR.K411.L			Advanced Sound and Vibration Measurement	1-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.D431)
		ENR.K412.L		★	Thermodynamics of Nonequilibrium Systems	1-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.E431)
		ENR.K413.L		★	Properties of Solid Materials	1-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.E432)
		ENR.K414.L		★	Advanced Thermal-Fluids Measurement	1-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.E433)
		ENR.K421.L		★	Computational Thermo-Fluid Dynamics	1-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering

									Graduate Major (MEC.F431)
		ENR.K422.L		★	Mechanical Processing	1-0-0	3	A	Course provided by the Mechanical Engineering Graduate Major (MEC.G431)
		ENR.K430.L		★ O	Advanced course of turbulent flow and control	1-0-0	3,5	A	☐Recognized as an ACEEES course; O: Taught in English in odd academic years
		ENR.K431.L			Metalforming	1-0-0	3	A	Course provided by the Mechanical Engineering Graduate Major (MEC.G432)
		ENR.K440.L			Advanced course of radiation transfer	1-0-0	3,5	A	☐Recognized as an ACEEES course
		ENR.K441.L			Advanced Mechanical Elements	1-0-0	3,5	A	Course provided by the Mechanical Engineering Graduate Major (MEC.H431)
		ENR.K450.L		★ O	Advanced course of combustion physics	1-0-0	3,5	A	☐Recognized as an ACEEES course; O: Taught in English in odd academic years
		ENR.K461.L			Mechatronics Device and Control	1-0-0	2,3	A	Course provided by the Mechanical Engineering Graduate Major (MEC.H433)
		ENR.K462.L			Advanced Course of Actuator Engineering	1-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.H434)
		ENR.K471.L			Ultra-precision Measurement	1-0-0	3	A	☐Recognized as an ACEEES course; Course provided by

									the Mechanical Engineering Graduate Major (MEC.J431)
		ENR.K472.L			Mechanism and Control for Ultra-precision Motion	1-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.J432)
		ENR.K491.L			Space Systems Design	2-0-0	2,3,4,5	A	Course provided by the Mechanical Engineering Graduate Major (MEC.M431)
		ENR.K492.L		★	Space Systems Analysis A	1-0-0	3	A	Course provided by the Mechanical Engineering Graduate Major (MEC.M433)
		Mechanical Engineering Course Track 500 Level							
		ENR.K501.L		★	Mechanics of High Temperature Materials	1-0-0	3,5	B	Course provided by the Mechanical Engineering Graduate Major (MEC.C531)
		ENR.K511.L			Experimental Modal Analysis for Structural Dynamics	1-0-0	3,5	B	Course provided by the Mechanical Engineering Graduate Major (MEC.D531)
		ENR.K521.L		★	Plasma Physics	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.E531)
		ENR.K530.L			Advanced course of multiscale thermal-fluid sciences	1-0-0	3	B	☐Recognized as an ACEEES course
		ENR.K531.L			Flying Object Engineering	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by

									the Mechanical Engineering Graduate Major (MEC.F531)
		ENR.K561.L			Rarefied Gas Dynamics	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Mechanical Engineering Graduate Major (MEC.F532)
		ENR.K562.L			Precision Manufacturing Processes	1-0-0	3,5	B	Course provided by the Mechanical Engineering Graduate Major (MEC.G531)
		ENR.K571.L			Advanced Course of Micro and Nano Machining	1-0-0	3	B	Course provided by the Mechanical Engineering Graduate Major (MEC.J532)
		ENR.K572.L			Advanced Tribosystem	1-0-0	3	B	Course provided by the Mechanical Engineering Graduate Major (MEC.J533)
		ENR.K580.L		★	Leading edge energy technology	1-0-0	1,3	B	☐Recognized as an ACEEES course
		ENR.K591.L		★	Space Systems Analysis B	1-0-0	3	B	Course provided by the Mechanical Engineering Graduate Major (MEC.M531)
		ENR.K592.L			Space Systems and Missions	2-0-0	3,4,5	B	Course provided by the Mechanical Engineering Graduate Major (MEC.M532)
		Electrical and Electronic Engineering Course Track 400 Level							
		ENR.L401.L		★	Mechanical-to-electrical energy conversion	2-0-0	3,5	A	☐Recognized as an ACEEES course
		ENR.L402.L			Utilization of Intelligent Information Resources and Patents	1-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by

									the Electrical and Electronic Engineering Graduate Major (EEE.G401)
		ENR.L410.L		★	Introduction to Photovoltaics	2-0-0	3,5		☐Recognized as an ACEEES course
		ENR.L411.L		★	Fundamentals of Electronic Materials	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D401)
		ENR.L412.L		★	Semiconductor Physics	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D411)
		ENR.L413.L			Electrical Modeling and Simulation	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.G411)
		ENR.L414.L		★	Electric Power and Motor Drive System Analysis	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.P401)
		ENR.L415.L		★	Advanced Course of Power Electronics	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic

									Engineering Graduate Major (EEE.P411)
		ENR.L416.L			Advanced Electric Power Engineering	2-0-0	2,3	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.P421)
		ENR.L417.L		★	Advanced Electromagnetic Waves	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.S401)
		ENR.L440.L		★	Mixed Signal Circuits	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.C411)
		ENR.L441.L			VLSI Technology I	2-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.C441)
		ENR.L442.L		★	VLSI Technology II	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.C442)

		ENR.L443.L		★	Bipolar Transistors and Compound Semiconductor Devices	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D451)
		ENR.L444.L			Advanced Power Semiconductor Devices	2-0-0	3,4,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D481)
		ENR.L445.L		★	Plasma Engineering	2-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.P451)
		ENR.L446.L		★	Pulsed Power Technology	2-0-0	3,4,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.P461)
		ENR.L447.L		★	Wireless Communication Engineering	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.S451)
		ENR.L448.L			Optical Communication Systems	2-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Electrical and

									Electronic Engineering Graduate Major (EEE.S461)
		Electrical and Electronic Engineering Course Track 500 Level							
		ENR.L501.L		★	Dielectric Property and Organic Devices	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D501)
		ENR.L502.L		★	Magnetic Levitation and Magnetic Suspension	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.P501)
		ENR.L511.L		★	Magnetism and Spintronics	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D511)
		ENR.L512.L			Environment and Electric Energy	2-0-0	2,4,5	B	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.P511)
		ENR.L530.L		★	Advanced Functional Electronic devices	2-0-0	1,2,3,4,5		☐Recognized as an ACEEES course
		ENR.L550.L			Nano-Structure Devices	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic

									Engineering Graduate Major (EEE.D551)
		ENR.L560.L		★	Terahertz Devices and Systems	2-0-0	3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D561)
		ENR.L580.L			Advanced Energy Electronics Devices	1-0-0	3,5	B	Course provided by the Electrical and Electronic Engineering Graduate Major (EEE.D582)
		Materials Science and Engineering Course Track 400 Level							
		ENR.J401.L		★	Advanced Metal Physics	2-0-0	2,3,5	B	☐Recognized as an ACEEES course
		ENR.J402.L		★	Physical Chemistry for High Temperature Processes -Thermodynamics-	1-0-0	3,5	A	☐Recognized as an ACEEES course
		ENR.J403.L		★	Physical Chemistry for High Temperature Processes -Smelting and Refining Processes-	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.J404.L		★	Physical Chemistry for High Temperature Processes -Oxidation of Metals-	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.J405.L		★ O	Microstructure Evolution and Diffusion in Metals	2-0-0	3,4,5	B	☐Recognized as an ACEEES course; O: English, E: Japanese
		ENR.J406.L			Organic Electronic Materials Physics	1-0-0	3	B	☐Recognized as an ACEEES course
		ENR.J407.L			Soft Materials Design	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.J408.L		★ O	Energy Conversion Ceramics Materials	2-0-0	3	B,C	☐Recognized as an ACEEES course O: English, E: Japanese
		ENR.J409.L			Introduction to Intellectual Property System	2-0-0	1,3,4,5	B,C	☐Recognized as an ACEEES course

		ENR.J410.L		★ O	Applied Diffraction Crystallography in Metals and Alloys	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M401); O: English, E: Japanese
		ENR.J411.L		★ E	Characterization of Nanomaterials	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M402); a: Held in 4Q O: Taught in Japanese in odd academic years E: Taught in English in even academic years b: Course spans 3–4Qs and taught every year in English at Tsinghua University
		ENR.J412.L		★ O	Environmental Degradation of Materials	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M403); O: English, E: Japanese
		ENR.J413.L		★ E	Transport Phenomena at High Temperature	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major

									(MAT.M404); O: Japanese, E: English
		ENR.J414.L		★ E	Advanced Microstructure Design of Ferrous Materials	2-0-0	1,3,4	B	□Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M405); O: Japanese, E: English
		ENR.J415.L		★ O	Advanced Microstructure Design of Non-ferrous Materials	2-0-0	3,5	B	□Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M406); O: English, E: Japanese
		ENR.J416.L		★ O	Advanced Solid State Physics	2-0-0	3,5	B	□Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M407); O: English, E: Japanese 【O, E: English at Tsinghua Univ.】
		ENR.J417.L		★ E	Quantum Statistical Mechanics	2-0-0	1,3,5	B	□Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M408); O: Japanese, E: English

		ENR.J418.L		★ O	Thermodynamics for Phase Equilibria	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M409); O: English, E: Japanese
		ENR.J419.L		★ O	Deformation and Strength of Solids	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M410); O: English, E: Japanese
		ENR.J420.L		★ O	Phase Transformation and Microstructure Control	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.M411); O: English, E: Japanese
		ENR.J421.L			Organic Optical Materials physics	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P401)
		ENR.J422.L			Soft Materials Physical Chemistry	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P402)

		ENR.J423.L		★	Soft Materials Physics	1-0-0	1,3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P403)
		ENR.J424.L		★	Soft Materials Functional Physics	1-0-0	2,3	B	Course provided by the Materials Science and Engineering Graduate Major (MAT.P404)
		ENR.J425.L		★ O	Soft Materials Chemistry I	1-0-0	3	B	Course provided by the Materials Science and Engineering Graduate Major (MAT.P411); Available in odd academic years
		ENR.J426.L		★ O	Soft Materials Chemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P412); Available in odd academic years
		ENR.J427.L			Soft Materials Functional Chemistry	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P413)
		ENR.J428.L			Soft Materials Function	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials

									Science and Engineering Graduate Major (MAT.P414)
		ENR.J429.L			Organic Materials Functional Design	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P421)
		ENR.J430.L			Organic Materials Design	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P422)
		ENR.J431.L			Advanced Course in Composite Materials	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P423)
		ENR.J432.L			Advanced Course in Polymer Processing A	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P424)
		ENR.J433.L			Advanced Course in Polymer Processing B	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P425)

		ENR.J434.L			Materials Engineering and Ecology	1-0-0	2,4,5	D	Course provided by the Materials Science and Engineering Graduate Major (MAT.P491)
		ENR.J435.L			Advanced Course in Organic Polymer Science	1-0-0	3	B,C	Course provided by the Materials Science and Engineering Graduate Major (MAT.P492)
		ENR.J436.L			Chemistry of Organic Materials	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P415)
		ENR.J437.L			Thermal Properties of Materials	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.P426)
		ENR.J438.L			Crystals Science	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C400)
		ENR.J439.L			Advanced Course of Dielectric and Ferroelectric Materials	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C401)

		ENR.J440.L			Quantum Physics in Optical Response of Materials	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C402)
		ENR.J441.L			Advanced Course of Ceramic Thin Film Technology	2-0-0	3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C403)
		ENR.J442.L			Physics and Chemistry of Semiconductors	2-0-0	1,3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C404)
		ENR.J443.L			Advanced Course of Instrumental Analysis for Materials	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C405)
		ENR.J444.L			Advanced Course of Magnetism	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C406)
		ENR.J445.L		★	Nuclear Materials and Structures	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Nuclear

									Engineering Graduate Major (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	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (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	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C501)
		ENR.J503.L			Advanced Course of Material Development I	2-0-0	3,5	B,C	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C502)
		ENR.J504.L		★	Advanced Course of Material Development II	2-0-0	3	B,C	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major (MAT.C503)
		ENR.J505.L			Functional Devices	2-0-0	1,3	B	☐Recognized as an ACEEES course; Course provided by the Materials Science and Engineering Graduate Major

									(MAT.C504)
		Chemical Science and Engineering Course Track 400 Level							
		ENR.H401.L			Advanced Photochemistry I	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H402.L			Advanced Photochemistry II	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H403.L			Advanced Electrochemistry I	1-0-0	3	B	☐Recognized as an ACEEES course
		ENR.H404.L			Advanced Electrochemistry II	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H405.L			Advanced Inorganic Materials Chemistry I	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H406.L			Advanced Inorganic Materials Chemistry II	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H407.L			Advanced Solid State Chemistry Oriented for Energy and Environment Issues I	1-0-0	3,4,5	B	☐Recognized as an ACEEES course
		ENR.H408.L			Advanced Solid State Chemistry Oriented for Energy and Environment Issues II	1-0-0	3,4,5	B	☐Recognized as an ACEEES course
		ENR.H409.L			Topics in Organic Electronics	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H410.L			Topics in Properties of Semiconductors	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H411.L			Topics in Applied Electrochemistry	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H412.L			Advanced Organic Electrochemistry	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H413.L			Advanced Functional Polymer Materials I	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H414.L			Advanced Functional Polymer Materials II	1-0-0	3,5	B	☐Recognized as an ACEEES course
		ENR.H416.L		★ O	Advanced Electrochemistry	2-0-0	3	B	O: Available in odd academic years; ☐Recognized as an ACEEES course
		ENR.H417.L		★ O	Organic Molecular and Macromolecular Chemistry	2-0-0	3	B	O: Available in odd academic years; ☐Recognized as an ACEEES course
		ENR.H418.L		★ E	Inorganic Materials Science	2-0-0	3,5	B	E: Available in even academic years; ☐Recognized as an ACEEES course

		ENR.H419.L		★ E	Organic Electrode Process	2-0-0	3,5	B	E: Available in even academic years; ☐Recognized as an ACEEES course
		ENR.H421.L			Advanced Electrochemistry I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A441)
		ENR.H422.L			Advanced Electrochemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A442)
		ENR.H423.L			Advanced Instrumental Analysis	1-0-0	3,5	B	Course provided by the Chemical Science and Engineering Graduate Major (CAP.A481)
		ENR.H424.L			Scope of Chemical Science and Engineering IA	1-0-0	3	B	Course provided by the Chemical Science and Engineering Graduate Major (CAP.A401)
		ENR.H425.L			Scope of Chemical Science and Engineering IIA	1-0-0	3	B	Course provided by the Chemical Science and Engineering Graduate Major (CAP.A402)
		ENR.H426.L			Advanced Design of Organic Reaction Processes I	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering

									Graduate Major (CAP.A421)
		ENR.H427.L			Advanced Design of Organic Reaction Processes II	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A422)
		ENR.H428.L			Advanced Organic Synthesis I	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A423)
		ENR.H429.L			Advanced Organic Synthesis II	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A424)
		ENR.H431.L			Advanced Solid State Chemistry I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A461)
		ENR.H432.L			Advanced Solid State Chemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A462)
		ENR.H433.L			Advanced Molecular Design of Metal Complexes I	1-0-0	3,5	B	Course provided by the Chemical

									Science and Engineering Graduate Major (CAP.A463)
		ENR.H434.L			Advanced Molecular Design of Metal Complexes II	1-0-0	3,5	B	Course provided by the Chemical Science and Engineering Graduate Major (CAP.A464)
		ENR.H435.L			Advanced Bioinorganic Chemistry I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A465)
		ENR.H436.L			Advanced Bioinorganic Chemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A466)
		ENR.H439.L			Advanced Solid-state Electrochemistry I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A443)
		ENR.H440.L			Advanced Solid-state Electrochemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A444)
		ENR.H441.L			Advanced Polymer Synthesis I	1-0-0	3,5	B	☐Recognized as an ACEEES course;

									Course provided by the Chemical Science and Engineering Graduate Major (CAP.P411)
		ENR.H442.L			Advanced Polymer Synthesis II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P412)
		ENR.H443.L			Advanced Polymer Properties I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P421)
		ENR.H444.L			Advanced Polymer Properties II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P422)
		ENR.H445.L			Advanced Polymer Structures I	1-0-0	3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P423)
		ENR.H446.L			Advanced Polymer Structures II	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering

									Graduate Major (CAP.P424)
		ENR.H447.L			Advanced Technology for Environmental Load Reduction I	1-0-0	1,3,5	A,C	Course provided by ACEEES (ACE.B441)
		ENR.H448.L			Advanced Technology for Environmental Load Reduction II	1-0-0	1,3,5	A,C	Course provided by ACEEES (ACE.B442)
		ENR.H451.L			Process Systems Engineering	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C412)
		ENR.H452.L			Advanced Energy Transfer Operation	2-0-0	3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C421)
		ENR.H453.L			Advanced Chemical Reaction Engineering	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C422)
		ENR.H454.L			Computational Fluid Dynamics	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C423)
		ENR.H455.L			Physico-Chemical Property Analysis in Chemical Engineering	2-0-0	3,4	B	☐Recognized as an ACEEES course; Course provided by the Chemical

									Science and Engineering Graduate Major (CAP.C432)
		ENR.H456.L			Transport Phenomena and Operation	2-0-0	1,3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C441)
		ENR.H457.L			Advanced Separation Operation	2-0-0	1,3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C442)
		ENR.H458.L		★	Chemical Engineering for Advanced Materials and Chemicals Processing I	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C411)
		ENR.H459.L		★	Chemical Engineering for Advanced Materials and Chemicals Processing II	1-0-0	3	A	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C431)
		ENR.H461.L			Advanced Organometallic Chemistry and Catalysis I	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T431)

		ENR.H462.L			Advanced Organometallic Chemistry and Catalysis II	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T432)
		ENR.H463.L			Introduction to Polymer Chemistry I	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T401)
		ENR.H464.L			Introduction to Polymer Physics II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T402)
		ENR.H465.L			Introduction to Polymer Chemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T403)
		ENR.H466.L			Introduction to Polymer Physics II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T404)
		ENR.H471.L			Advanced Coordination Chemistry	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical

									Science and Engineering Graduate Major (CAP.I403)
		ENR.H472.L			Environmental Chemistry	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I405)
		ENR.H473.L			Introduction to Chemical Engineering (Basics)	1-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I407)
		ENR.H474.L			Advanced Supramolecular Chemistry	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I413)
		ENR.H475.L			Environmental Analytical Chemistry	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I415)
		ENR.H476.L			Catalysis for the Environmental Issues	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I416)

		ENR.H477.L			Introduction to Chemical Engineering (Unit Operation)	1-0-0	3,5	A	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I417)
		ENR.H478.L			Advanced Organic Materials Chemistry	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I423)
		ENR.H479.L			Advanced Geochemistry	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I435)
		ENR.H481.L			Advanced Nano-Materials Chemistry I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I434)
		ENR.H482.L			Advanced Nano-Materials Chemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I444)
		ENR.H483.L		★ O	Coordination Chemistry	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical

									Science and Engineering Graduate Major (CAP.I471) Available in odd academic years
		ENR.H484.L		★ O	Advanced Catalytic Chemistry	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I472) Available in odd academic years
		ENR.H485.L		★ E	Nanotechnology and Nanoscience	2-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I473); Available in even academic years
		ENR.H486.L			Scope of Chemical Science and Engineering IB	1-0-0	3	A	Course provided by the Chemical Science and Engineering Graduate Major (CAP.I401)
		ENR.H487.L			Scope of Chemical Science and Engineering IIB	1-0-0	3	A	Course provided by the Chemical Science and Engineering Graduate Major (CAP.I402)
		ENR.H488.L			Introduction to the Frontiers of Environmental Chemistry I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering

									Graduate Major (CAP.I481)
		ENR.H489.L			Introduction to the Frontiers of Environmental Chemistry II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I482)
		Chemical Science and Engineering Course Track 500 Level							
		ENR.E521.L			Advanced Chemistry of Transition Metal Complexes I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A561)
		ENR.E522.L		★ O	Advanced Chemistry of Transition Metal Complexes II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A562) O: Taught in English in odd academic years
		ENR.E541.L			Advanced Polymer Reactions	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P511)
		ENR.E542.L			Advanced Polymer Processing	1-0-0	3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering

									Graduate Major (CAP.P581)
		ENR.E543.L			Advanced Polymer Science I	1-0-0	1,3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P582)
		ENR.E544.L			Advanced Polymer Science II	1-0-0	1,3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.P583)
		ENR.E551.L			Chemical Engineering in Global Business	1-0-0	1,2,3,5	B	Course provided by the Chemical Science and Engineering Graduate Major (CAP.C521)
		ENR.E552.L			Advanced Chemical Equipment Design	2-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C531)
		ENR.E553.L			Advanced Specific Environmental Process	2-0-0	3,4	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C532)
		ENR.E554.L			Advanced Nanoscale Chemical Process	2-0-0	1,3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical

									Science and Engineering Graduate Major (CAP.C541)
		ENR.E561.L			Advanced Catalytic Reactions I	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T531)
		ENR.E562.L			Advanced Catalytic Reactions II	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.T532)
		ENR.E571.L			Advanced Strategic Organic Synthesis	1-0-0	3	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I533)
		ENR.E572.L			Material Cycle Analysis	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I535)
		ENR.E573.L			Systematic Material Design Methodology	1-0-0	4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I537)

		ENR.E574.L			Advanced Course in Macromolecular Materials I	1-0-0	3,5	B	Course provided by the Chemical Science and Engineering Graduate Major (CAP.I539)
		ENR.E575.L			Advanced Process Dynamics and Control	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I547)
		ENR.E576.L			Advanced Course in Macromolecular Materials II	1-0-0	3,4,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.I549)
		ENR.H501.L		★	Advanced Chemical Materials for Energy Issues I	1-0-0	3,4,5	B	☐Recognized as an ACEEES course
		ENR.H502.L		★	Advanced Chemical Materials for Energy Issues II	1-0-0	3,4,5	B	☐Recognized as an ACEEES course
		ENR.H503.L		★	Advanced Polymer Design for Energy Materials	1-0-0	3,4,5	B	☐Recognized as an ACEEES course
		ENR.H523.L		★ O	Advanced Molecular Design for Organic Synthesis I	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.A521); O: Taught in English in odd academic years
		ENR.H524.L			Advanced Molecular Design for Organic Synthesis II	1-0-0	3,5	B	☐Recognized as an ACEEES course; Course provided by the Chemical Science and

									Engineering Graduate Major (CAP.A522)
		ENR.H555.L		★	Life Cycle Engineering	2-0-0	3,5	B	□Recognized as an ACEEES course; Course provided by the Chemical Science and Engineering Graduate Major (CAP.C511)

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, Leading Graduate School (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: 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 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.R433			Off-campus Project M3c	0-0-3	C1M	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R434			Off-campus Project M4c	0-0-4	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 Engineering A1	0-0-1	C1M	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A461			Off-campus Project in Materials 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 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 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

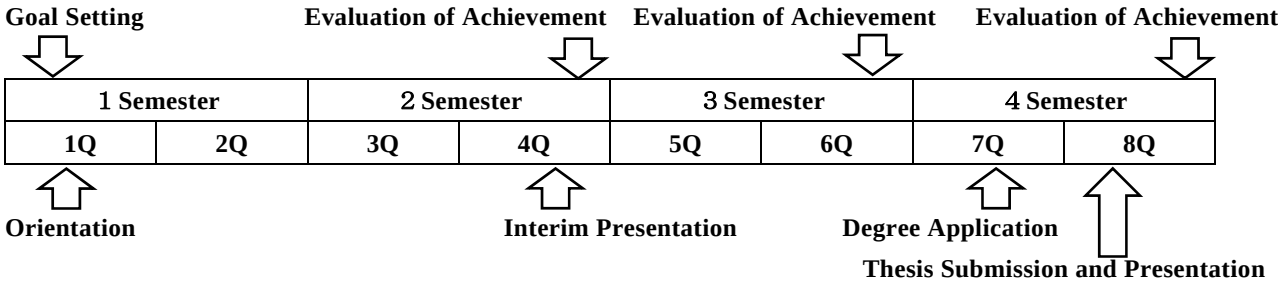
								Science and Engineering only
	ENR.B520.L		★	TSE Energy International Workshop B	0-0-1	C1M	C,E	For students affiliated with the Department of Transdisciplinary Science and Engineering only
	ENR.B521.L		★	TSE Energy International Workshop C	0-0-1	C1M	C,E	For students affiliated with the Department of Transdisciplinary 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

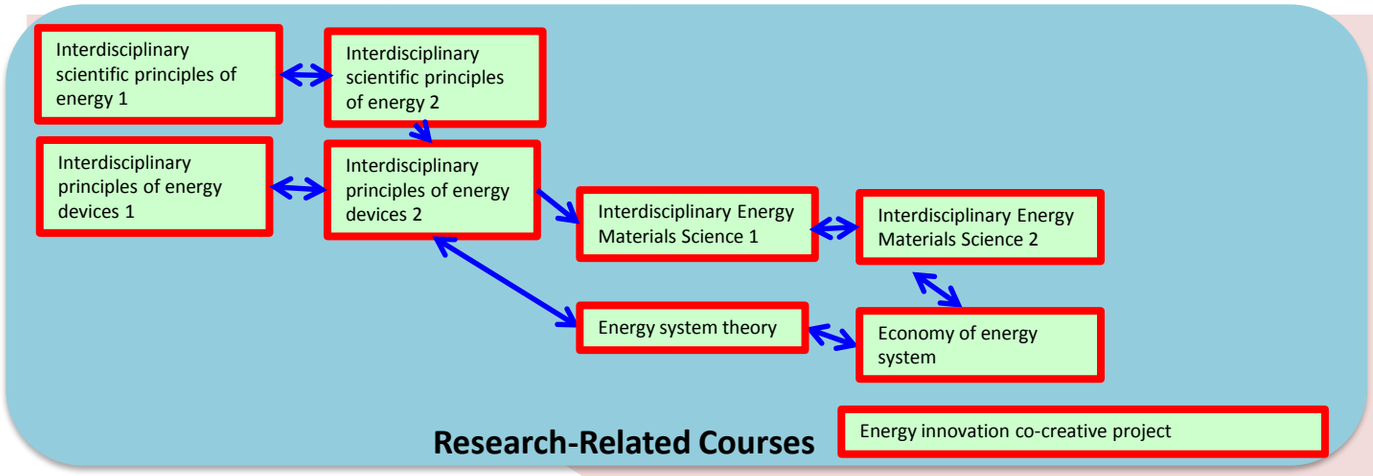
Prior to the final screening, the thesis will be reviewed by examiners. Final screening and evaluation of the thesis is based on the student's oral presentation. Oral presentation must be carried out in English or Japanese.

【Department of 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

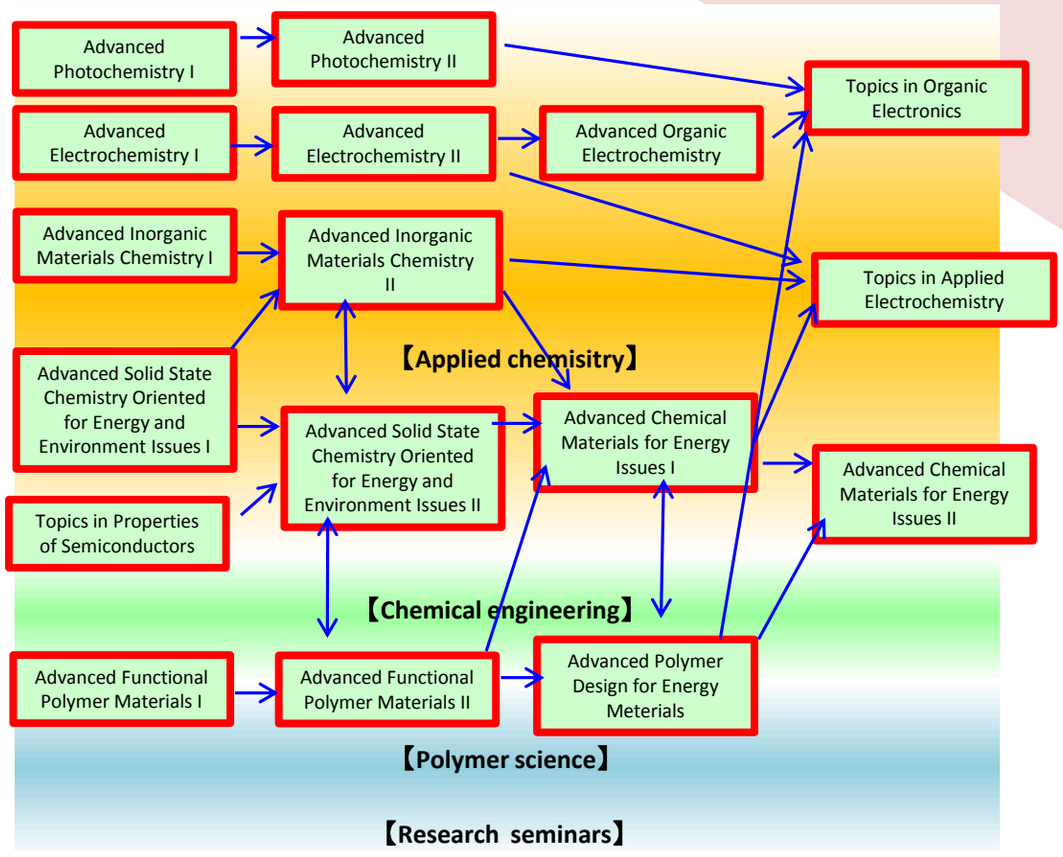
Interdisciplinary Scientific Principles of Energy Courses



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 Catalytic Reactions I	Advanced Organo-metallic Chemistry and Catalysis I
Advanced Coordi-nation Chemistry	Material Cycle Analysis	Advanced Nano-Materials Chemistry I	Advanced Catalytic Reactions II	Advanced Electrochemistry I
Environmental Analytical Chemistry	Advanced Instru-mental Analysis	Advanced Nano-Materials Chemistry II	Advanced Organo-metallic Chemistry and Catalysis I	Advanced Electrochemistry II
Catalysis for the Environmental Issues	Advanced Supra-molecular Chemistry		Advanced Chemistry of Transition Metal Complexes I	Advanced Chemistry of Transition Metal Complexes II
Geochemistry				

Chemical engineering　1①～2④

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

Polymer science ①～2④

Introduction to Polymer Chemistry I	Introduction to Polymer Physics I	Advanced Polymer Synthesis I	Advanced Polymer Properties I
(Introduction to Polymer Chemistry II	Introduction to Polymer Physics II	Advanced Polymer Synthesis II	Advanced Polymer Properties II
Advanced Polymer Structures I	Advanced Course in Macromolecular Materials I	Advanced Course in Macromolecular Materials II	Advanced Polymer Processing
Advanced Polymer Structures II	Advanced Polymer Science I	Advanced Polymer Science II	Advanced Polymer Reactions

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
				Advanced Data Analysis

Research Seminars

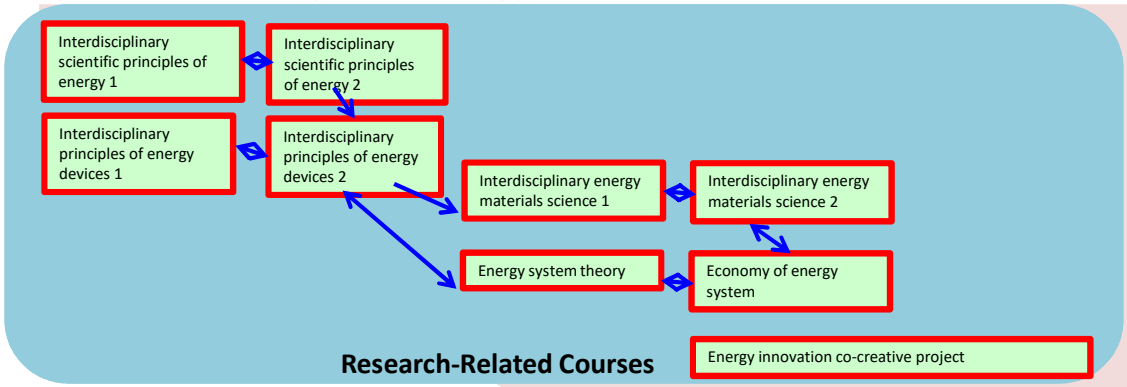
Seminar in energy science S1	Seminar in energy science F1
Seminar in energy science S2	Seminar in energy science F2

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

Required courses | Effective Courses

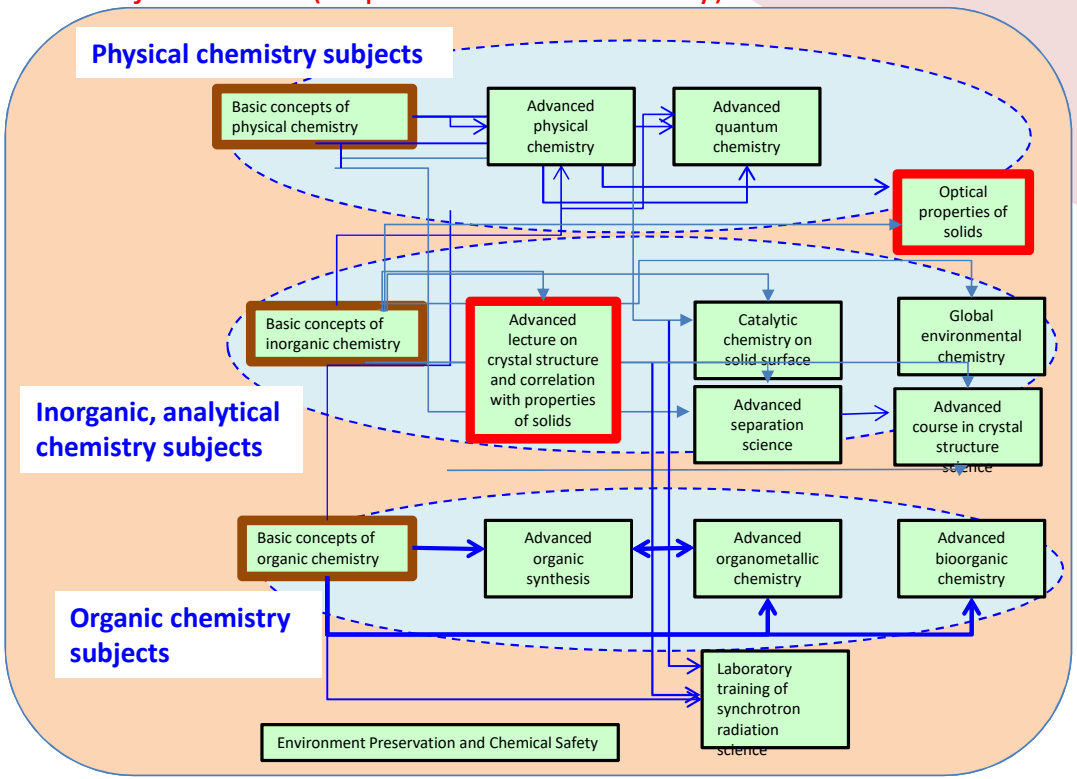
1①	1②	1③	1④	2①	2②	2③	2④

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

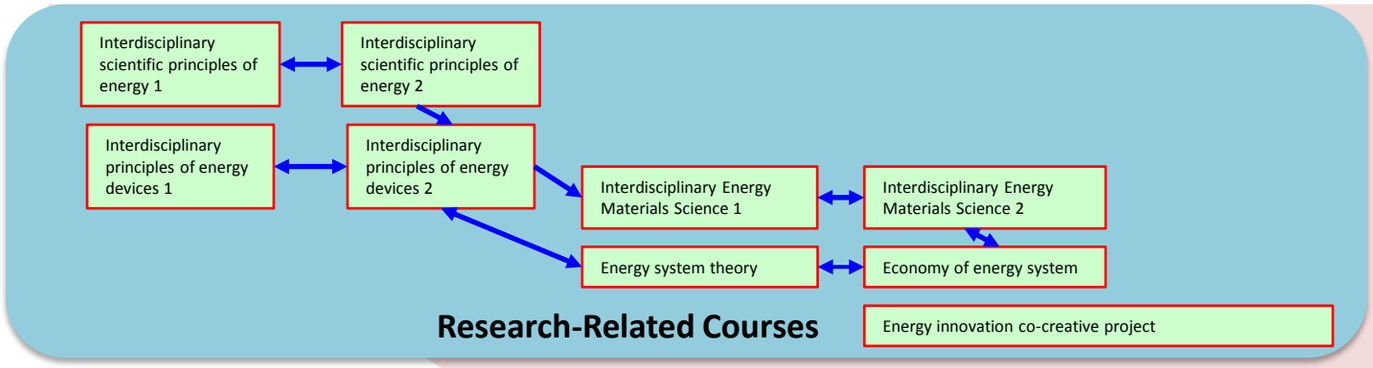
Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Department of 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

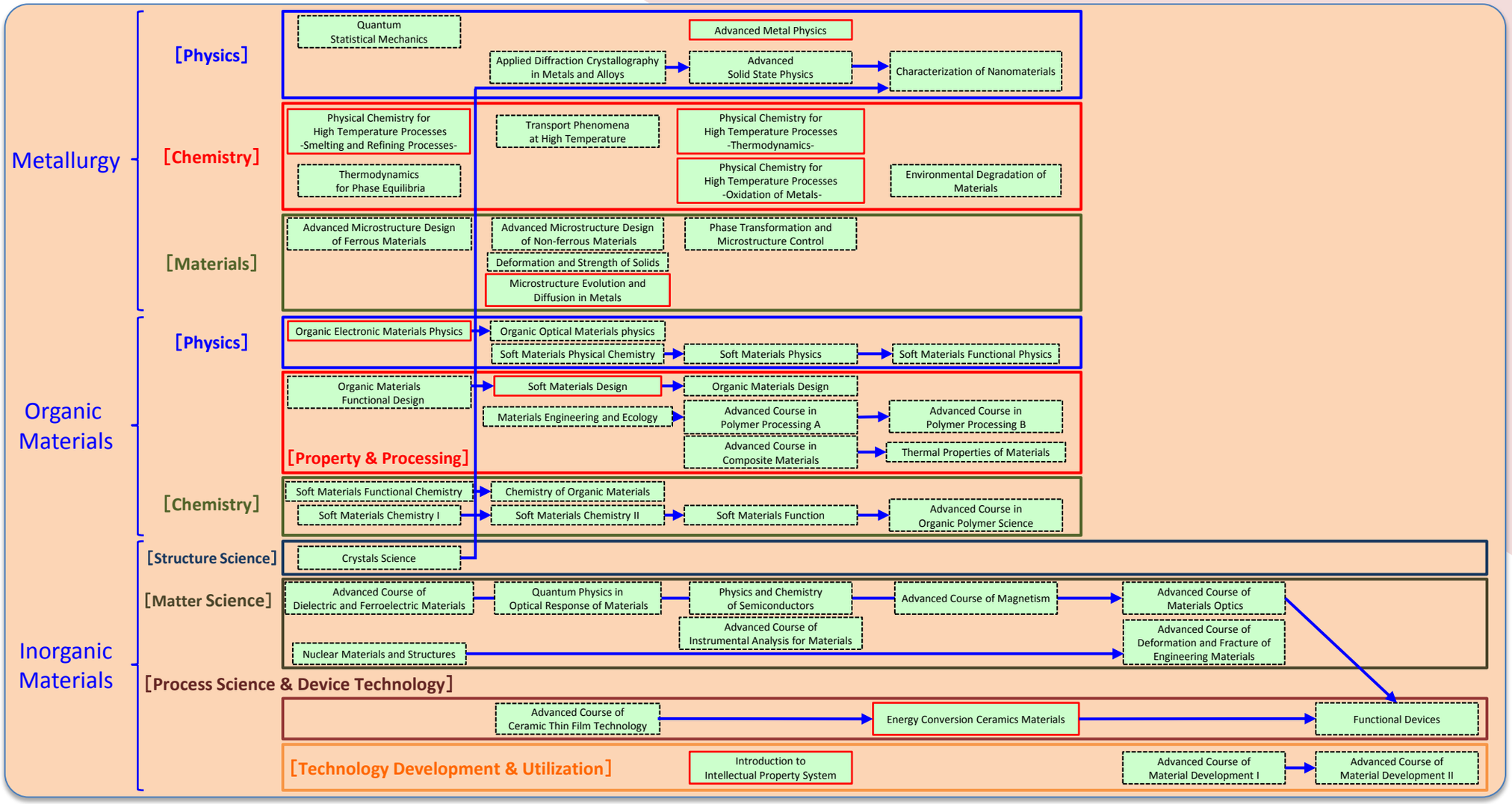
Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

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

Major Courses (Department of Materials Science and Engineering)



Research Seminars

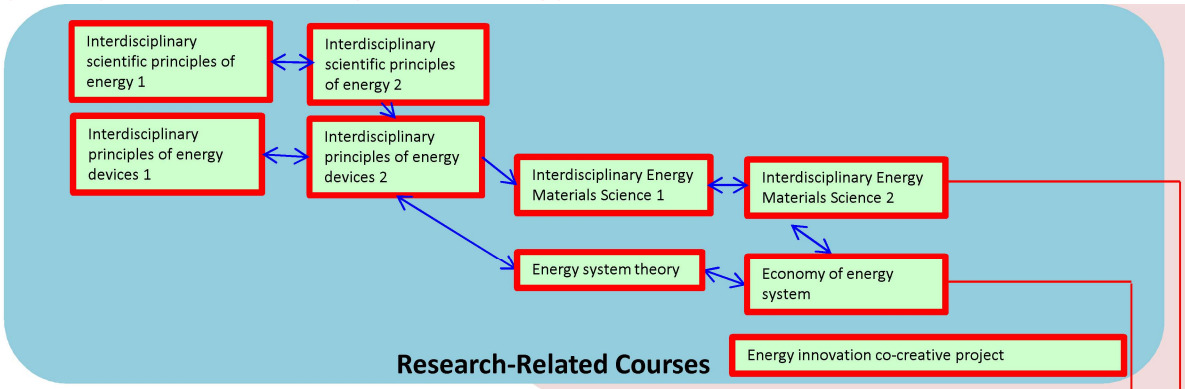
Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

【Department of 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

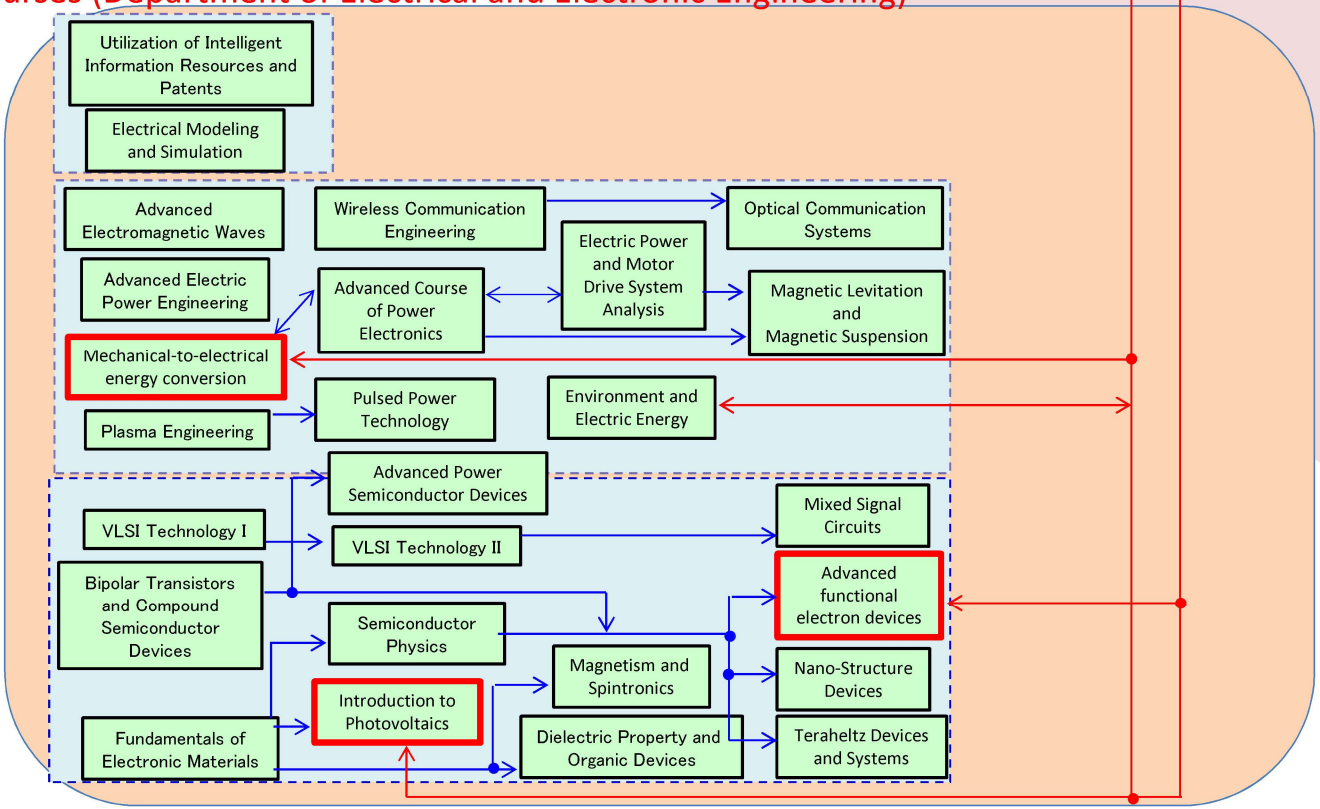
Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

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

Major Courses (Department of Electrical and Electronic Engineering)



Research Seminars

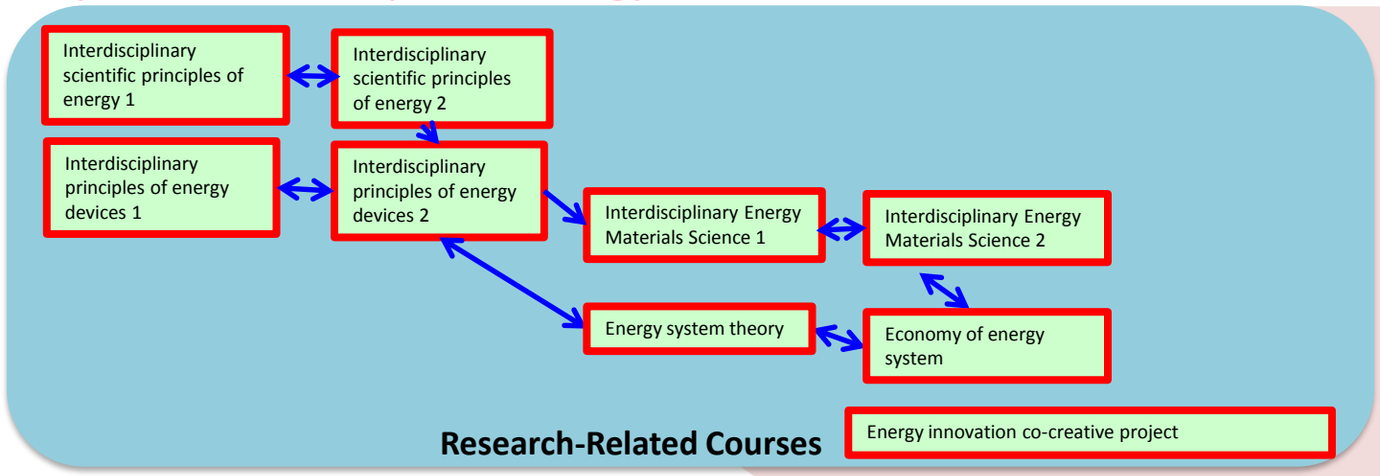
Seminar in energy science S1 | Seminar in energy science F1 | Seminar in energy science S2 | Seminar in energy science F2

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

Required Courses　Elective Courses

1①	1②	1③	1④	2①	2②	2③	2④

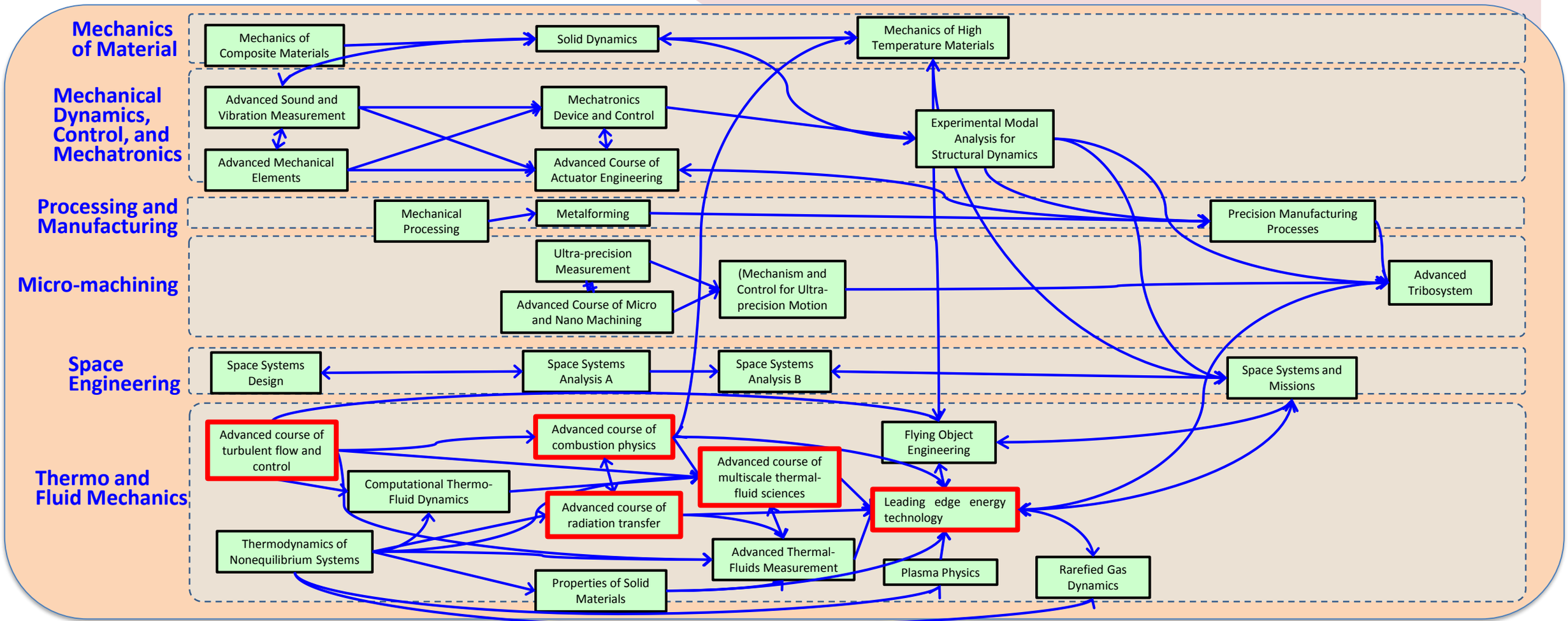
Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

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

Major Courses (Department of Mechanical Engineering)



Research Seminars

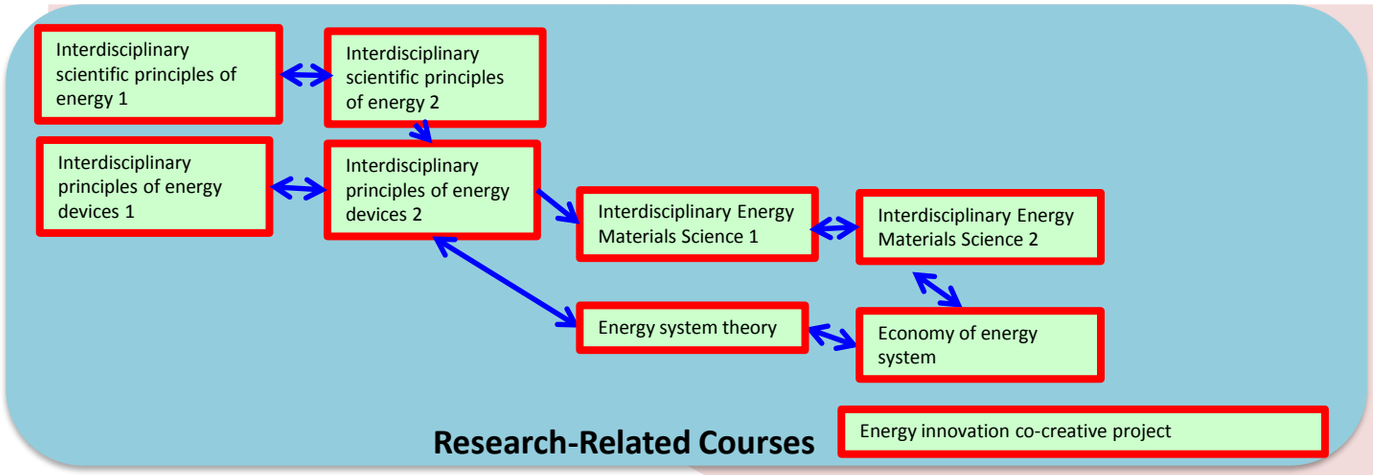
Seminar in energy science S1	Seminar in energy science F1	Seminar in energy science S2	Seminar in energy science F2

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

Required Courses　Elective Courses

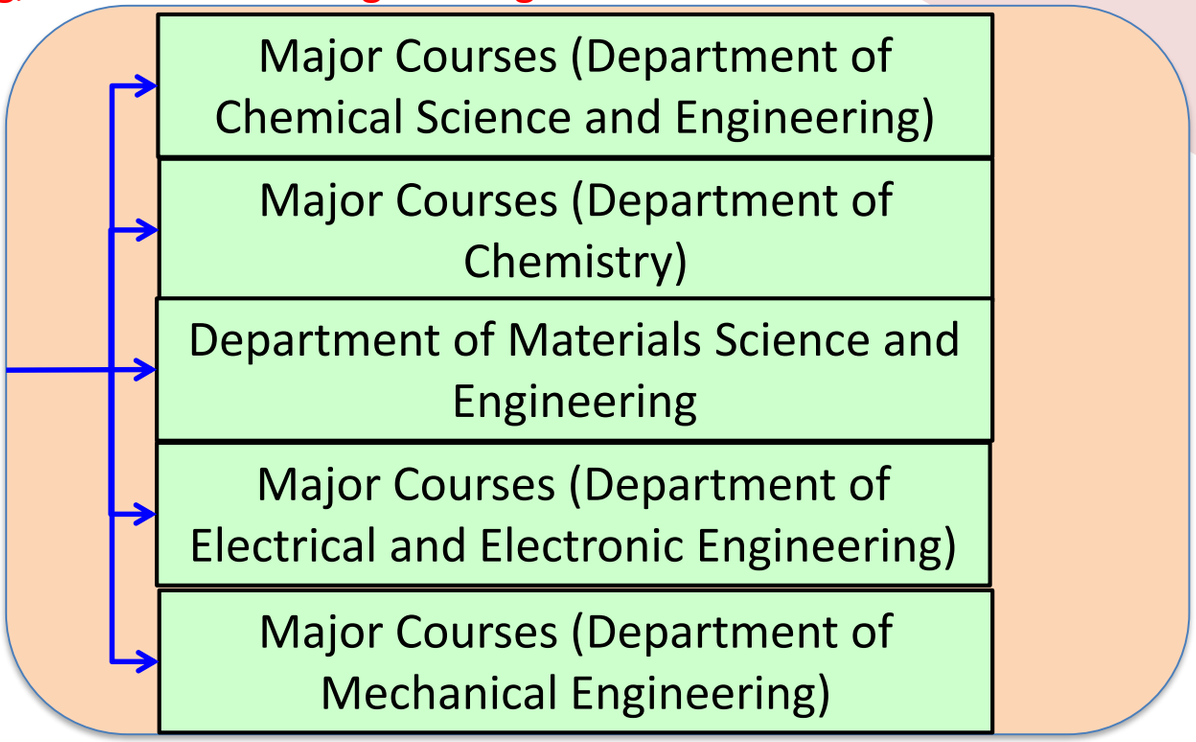
1①	1②	1③	1④	2①	2②	2③	2④

Interdisciplinary Scientific Principles of Energy Courses



Master's Thesis Research

Major Courses（Chemical Science and Engineering, Chemistry, Materials Science and Engineering, Electrical and Electronic Engineering, or 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	L		Practical Presentation A	0-0-1	2,3	A,B,C,E	
		ENR.E602.L	L		Practical Presentation B	0-0-1	2,3	A,B,C,E	
		ENR.E603.L	L		Practical Presentation C	0-0-1	2,3	A,B,C,E	
		ENR.E604.L	L	★	International scientific presentation A	0-0-1	2,3	A,B,C,D,E	
		ENR.E605.L	L	★	International scientific presentation B	0-0-1	2,3	A,B,C,D,E	
		ENR.E606.L	L	★	International scientific presentation C	0-0-1	2,3	A,B,C,D,E	
		ENR.E607.L	L		Practical research in energy science A	0-0-1	3,4	A,B,C	
		ENR.E608.L	L		Practical research in energy science B	0-0-1	3,4	A,B,C	
		ENR.E613.L	L		Practical research in energy science C	0-0-1	3,4	A,B,C	
		ENR.E614.L	L		Practical research in energy science D	0-0-1	3,4	A,B,C	
		ENR.E609.L	L		Academic teaching	0-1-0	2,3	D,E	

		ENR.E610.L	L	★	Academic Writing A	1-0-0	2,4	A,C,E	□Recognized as an ACEEES course
		ENR.E611.L	L	★	Academic Writing B	1-0-0	1,2,4	A,C,E	□Recognized as an ACEEES course
		ENR.E612.L	L	★	International energy project	0-0-2	1,2,4,5	C,D,E	
		ENR.E615.L	L		Special Experiment and Practice for Working Adults in Energy Science and Engineering 1	0-0-1	3,4,5	C	
		ENR. E616.L	L		Special Experiment and Practice for Working Adults in Energy Science and Engineering 2	0-0-1	3,4,5	C	
		ENR.E617.L	L		Special Experiment and Practice for Working Adults in Energy Science and Engineering 3	0-0-1	3,4,5	C	
		ENR.P601.L	L	★	Energy Science and Engineering Project	0-0-2	2,4	A,E	
		ENR.R602.L	L	★	Energy Science and Engineering Off-Campus Project D1c	0-0-2	2,4,5	A,C,E	
		ENR.R603.L	L	★	Energy Science and Engineering Off-Campus Project D2c	0-0-4	2,4,5	A,C,E	

Note：

• ◎：Required course, L：Elective course

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

• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills;
5 = Practical and/or problem-solving skills

• The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ENR.D400.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 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 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	B,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	B,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 A2D A3D	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	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	C,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 P3D	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	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								

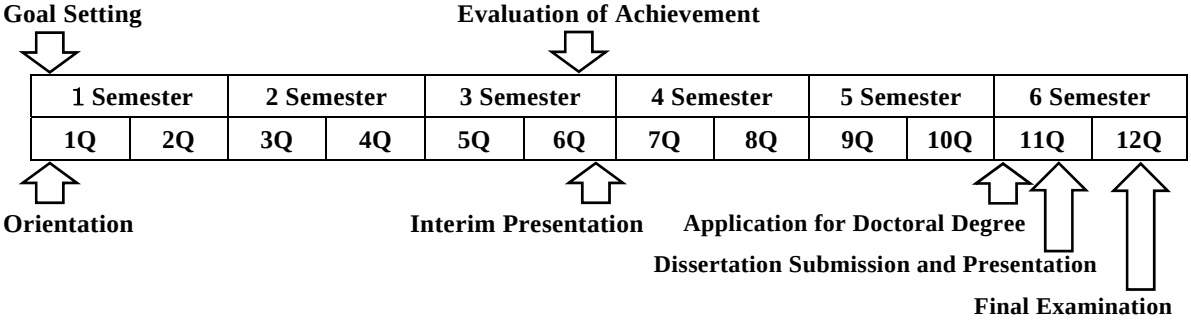
the Liberal Arts and Basic Science Courses Guide.

＊GA: Graduate Attributes

Students enrolled in the educational program for leading graduate schools 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