

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, material, equipment, and electricity)
- 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 themes
- Ability to find new directions on energy issues by diverse thinking
- Global communication skills

3. Learning Goals

The students will learn about,

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, equipment, and electricity.

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, material, equipment, and electricity.

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

E) Communication Skills

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. A total of 30 credits or more acquired from 400- and 500-level courses.
2. From the courses specified in the Graduate Major in Energy Science and Engineering curriculum below,
 - Minimum of 25 credits acquired from major courses and research seminars
 - Minimum of 4 credits from “Interdisciplinary Scientific Principles of Energy Courses” and minimum 4 credits from the major courses in the department where the student belongs. For students in the Department of Chemistry, minimum 4 credits from the Chemistry Major Courses (*), and for students in Department of Transdisciplinary Science and Engineering, 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 S1, F1, S2, and F2); and
 - Minimum of 5 credits acquired from Liberal Arts and Basic Science Courses (3 credits from the 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. 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 One credit from 500-level	5 credits	D	
	Career development courses		2 credits from 400- and 500- levels		C,D,E	
	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		Minimum of 4 credits from “Interdisciplinary Scientific Principles of Energy Courses” and minimum 4 credits from the Major Courses in the student’s department. For students in Department of Chemistry, minimum of 4 credits from the Chemistry major courses (*), and for students in Department of Transdisciplinary Science and Engineering, minimum of 4 credits from energy major courses in other departments that offer Graduate Major in Energy Science and Engineering.		A,B	
	Major courses and Research-relate d Courses <u>outside</u> the Graduate					

	Major in Energy Science Engineering standard curriculum					
Total required credits		A minimum of 30 credits in addition to meeting the above conditions				
Note		- Japanese Language and Culture Courses offered to International Students can be recognized as Humanities and Social Science Courses of the corresponding course level - As for Liberal Arts and Basic Science Courses, please refer to the relevant pages.				

5. IGP Courses

Table M2. Core Courses of the Graduate Major in Energy Science and Engineering

Course category		Course number	Course			Credits	Competencies	Learning goals	Comments
Research seminars	400 level	ENR.Z491.R	◎		Seminar in energy science S1	0-0-2	2,3,4,5	A,B,C	☐
		ENR.Z492.R	◎		Seminar in energy science F1	0-0-2	2,3,4,5	A,B,C	☐
	500 level	ENR.Z591.R	◎		Seminar in energy science S2	0-0-2	2,3,4,5	A,B,C	☐
		ENR.Z592.R	◎		Seminar in energy science F2	0-0-2	2,3,4,5	A,B,C	☐
Research-related courses	400 level	ENR.E491.L			Environment Preservation and Chemical Safety I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.E401)
		ENR.E492.L			Environment Preservation and Chemical Safety II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.E402)
		ENR.E493.L			Advanced Internship in Chemical Science and Engineering	0-0-1	1,2,5	B D	【Chemical Science and Engineering】(CAP.E411)
		ENR.E494.L			Advanced Data Analysis	1-0-0	3,5	E or B	☐ 【Chemical Science and Engineering】(CAP.E421)
		ENR.E495.L			Presentation Practice	0-1-0	2,5	E or BD	☐ 【Chemical Science and Engineering】(CAP.E422)
	500 level	ENR.B502.L			Energy innovation co-creative project	0-0-1	1,2,3,4,5	A,C,E	☐
		ENR.H591.L			Scientific Ethics	1-0-0	3,5	D or BD	☐ 【Chemical Science and Engineering】(CAP.E521)
Major courses	400 level	ENR.A401.A	○		Interdisciplinary scientific principles of energy 1	1-0-0	3,4,5	A, C	☐
		ENR.A402.A	○		Interdisciplinary scientific principles of energy 2	1-0-0	3,4,5	A, C	☐
		ENR.A403.A	○		Interdisciplinary principles of energy devices 1	1-0-0	3,5	A, C	☐

		ENR.A404.A	○		Interdisciplinary principles of energy devices 2	1-0-0	3,4,5	A, C	☐
		ENR.A405.A	○		Interdisciplinary Energy Materials Science 1	1-0-0	3,4,5	A, C	☐
		ENR.A406.A	○		Interdisciplinary Energy Materials Science 2	1-0-0	3,4,5	A, C	☐
		ENR.A407.A	○		Energy system theory	1-0-0		A, C	☐
		ENR.A408.A	○		Economy of energy system	1-0-0	3,4,5	A, C	☐
		ENR.B430.L			Advanced Science and Technology in Energy and Environment	2-0-0	3,5	A, C	☐
		ENR.B431.L		★	Recent technologies of fuel cells, solar cells, batteries and energy system	2-0-0	1,2,3,4,5	A, C	☐ 【SGU summer program】
		ENR.H401.L			Advanced Photochemistry I	1-0-0	3,5	B	☐
		ENR.H402.L			Advanced Photochemistry II	1-0-0	3,5	B	☐
		ENR.H403.L			Advanced Electrochemistry I	1-0-0	3	B	☐
		ENR.H404.L			Advanced Electrochemistry II	1-0-0	3,5	B	☐
		ENR.H405.L			Advanced Inorganic Materials Chemistry I	1-0-0	3,5	B	☐
		ENR.H406.L			Advanced Inorganic Materials Chemistry II	1-0-0	3,5	B	☐
		ENR.H407.L			Advanced Solid State Chemistry Oriented for Energy and Environment Issues I	1-0-0	3,4,5	B	☐
		ENR.H408.L			Advanced Solid State Chemistry Oriented for Energy and Environment Issues II	1-0-0	3,4,5	B	☐
		ENR.H409.L			Topics in Organic Electronics	1-0-0	3,5	B	☐
		ENR.H410.L			Topics in Properties of Semiconductors	1-0-0	3,5	B	☐
		ENR.H411.L			Topics in Applied Electrochemistry	1-0-0	3,5	B	☐
		ENR.H412.L			Advanced Organic Electrochemistry	1-0-0	3,5	B	☐
		ENR.H413.L			Advanced Functional Polymer Materials I	1-0-0	3,5	B	☐
		ENR.H414.L			Advanced Functional Polymer Materials II	1-0-0	3,5	B	☐
		ENR.H416.L		★ O	Advanced Electrochemistry	2-0-0		B	
		ENR.H417.L		★ O	Organic Molecular and Macromolecular Chemistry	2-0-0		B	

	ENR.H418.L		★ E	Inorganic Materials Science	2-0-0	3,5	B	
	ENR.H419.L		★ E	Organic Electrode Process	2-0-0	3,5	B	
	ENR.J401.L		★	Advanced Metal Physics	2-0-0	2,3,5	B	☐
	ENR.J402.L		★	Physical Chemistry for High Temperature Processes -Thermodynamics-	1-0-0	3,5	A	☐
	ENR.J403.L		★	Physical Chemistry for High Temperature Processes -Smelting and Refining Processes-	1-0-0	3,5	B	☐
	ENR.J404.L		★	Physical Chemistry for High Temperature Processes -Oxidation of Metals-	1-0-0	3,5	B	☐
	ENR.J405.L		★ O	Microstructure Evolution and Diffusion in Metals	2-0-0	3,4,5	B	☐ (O: English, E: Japanese)
	ENR.J406.L			Organic Electronic Materials Physics	1-0-0	3	B	☐
	ENR.J407.L			Soft Materials Design	1-0-0	3,5	B	☐
	ENR.J408.L		★ O	Energy Conversion Ceramics Materials	2-0-0	3	B,C	☐ (O: English, E: Japanese)
	ENR.J409.L			Introduction to Intellectual Property System	1-0-0	3,5	B,C	☐
	ENR.K430.L		★ O	Advanced course of turbulent flow and control	1-0-0	3,5	A	☐ (O: English, E: Japanese)
	ENR.K440.L		★	Advanced course of radiation transfer	1-0-0	3,5	A	☐
	ENR.K450.L		★ O	Advanced course of combustion physics	1-0-0	3,5	A	☐ (O: English, E: Japanese)
	ENR.L401.L		★	Mechanical-to-electrical energy conversion	2-0-0	3,5		☐
	ENR.L410.L		★	Introduction to Photovoltaics	2-0-0	3,5		☐
	ENR.H424.L			Scope of Chemical Science and Engineering IA	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A401)
	ENR.H425.L			Scope of Chemical Science and Engineering IIA	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A402)
	ENR.H426.L			Advanced Design of Organic Reaction Processes I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A421)
	ENR.H427.L			Advanced Design of Organic Reaction Processes II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A422)
	.H428.L			Advanced Organic I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A423)

			ENR.H429.L			Advanced Organic Synthesis II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A424)
			ENR.H431.L			Advanced Solid State Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A461)
			ENR.H432.L			Advanced Solid State Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A462)
			ENR.H433.L			Advanced Molecular Design of Metal Complexes I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A463)
			ENR.H434.L			Advanced Molecular Design of Metal Complexes II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A464)
			ENR.H435.L			Advanced Bioinorganic Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A465)
			ENR.H436.L			Advanced Bioinorganic Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A466)
		★	ENR.H458.L			Chemical Engineering for Advanced Materials and Chemicals Processing I	1-0-0	3,5	A	【Chemical Science and Engineering】(CAP.C411)
		★	ENR.H459.L			Chemical Engineering for Advanced Materials and Chemicals Processing II	1-0-0	3	A	【Chemical Science and Engineering】(CAP.C431)
		★ O	ENR.H483.L			Coordination Chemistry	2-0-0		B	【Chemical Science and Engineering】(CAP.I471)
		★ O	ENR.H484.L			Advanced Catalytic Chemistry	2-0-0	3	B	【Chemical Science and Engineering】(CAP.I472)
		★ E	ENR.H485.L			Nanotechnology and Nanoscience	2-0-0	3	B	【Chemical Science and Engineering】(CAP.I473)
			ENR.H486.L			Scope of Chemical Science and Engineering IB	1-0-0	3	A	【Chemical Science and Engineering】(CAP.I401)
			ENR.H487.L			Scope of Chemical Science and Engineering IIB	1-0-0	3	A	【Chemical Science and Engineering】(CAP.I402)
			ENR.H488.L			Introduction to the Frontiers of Environmental Chemistry I	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I481)
			ENR.H489.L			Introduction to the Frontiers of Environmental Chemistry II	1-0-0	3	B	【Chemical Science and Engineering】(CAP.I482)
		★	ENR.J445.L			Nuclear Materials and Structures	2-0-0	3	B	□【Nuclear Engineering】(NCL.N403)
			ENR.J436.L			Chemistry of Organic Materials	1-0-0	3	B	【Materials Science and Engineering】(MAT.P415)
			ENR.J437.L			Thermal Properties of Materials	1-0-0	3,5	B	【Materials Science and Engineering】(MAT.P426)
			ENR.I431.L			Laboratory Training of Synchrotron Radiation Science	0-0-1	3,5	B D	【Chemistry】(CHM.A431)
		★	ENR.I435.L			Current Chemistry I	1-0-0	1,2,3	B D	【Chemistry】(CHM.A435)
		★	ENR.I436.L			Current Chemistry II	1-0-0	1,3	B D	【Chemistry】(CHM.A436)

	ENR.I437.L	★	Current Chemistry III	1-0-0		B D	【Chemistry】(CHM.A437)
	ENR.I438.L	★	Current Chemistry IV	1-0-0		B D	【Chemistry】(CHM.A438)
	ENR.I401.L		Basic Concepts of Inorganic Chemistry	2-0-0	3	A	【Chemistry】(CHM.B401)
	ENR.I402.L		Basic Concepts of Physical Chemistry	2-0-0	3	A	【Chemistry】(CHM.C401)
	ENR.I403.L		Basic Concepts of Organic Chemistry	2-0-0	3	A	【Chemistry】(CHM.D401)
	ENR.K401.L		Mechanics of Composite Materials	1-0-0	3	A	【Mechanical Engineering】(MEC.C431)
	ENR.K402.L		Solid Dynamics	1-0-0	3	A	【Mechanical Engineering】(MEC.C433)
	ENR.K411.L		Advanced Sound and Vibration Measurement	1-0-0	3	A	【Mechanical Engineering】(MEC.D431)
	ENR.K412.L	★	Thermodynamics of Nonequilibrium Systems	1-0-0	3	A	□【Mechanical Engineering】(MEC.E431)
	ENR.K413.L	★	Properties of Solid Materials	1-0-0	3	A	□【Mechanical Engineering】(MEC.E432)
	ENR.K414.L	★	Advanced Thermal-Fluids Measurement	1-0-0	3,5	A	□【Mechanical Engineering】(MEC.E433)
	ENR.K421.L	★	Computational Thermo-Fluid Dynamics	1-0-0	3	A	□【Mechanical Engineering】(MEC.F431)
	ENR.K422.L		Mechanical Processing	1-0-0	3	A	【Mechanical Engineering】(MEC.G431)
	ENR.K431.L		Metallforming	1-0-0	3	A	【Mechanical Engineering】(MEC.G432)
	ENR.K441.L	★	Advanced Mechanical Elements	1-0-0	3,5	A	【Mechanical Engineering】(MEC.H431)
	ENR.K461.L		Mechatronics Device and Control	1-0-0	2,3	A	【Mechanical Engineering】(MEC.H433)
	ENR.K462.L	★	Advanced Course of Actuator Engineering	1-0-0	3,5	A	□【Mechanical Engineering】(MEC.H434)
	ENR.K471.L		Ultra-precision Measurement	1-0-0	3	A	【Mechanical Engineering】(MEC.J431)
	ENR.K472.L		Mechanism and Control for Ultra-precision Motion	1-0-0	3,5	A	【Mechanical Engineering】(MEC.J432)
	ENR.K491.L		Space Systems Design	2-0-0	2,3,4,5	A	【Mechanical Engineering】(MEC.M431)
	ENR.K492.L	★	Space Systems Analysis A	1-0-0	3	A	【Mechanical Engineering】(MEC.M433)
	ENR.L440.L	★	Mixed Signal Circuits	2-0-0	3,5	A	□【Electrical and Electronic Engineering】(EEE.C411)
	ENR.L441.L		VLSI Technology I	2-0-0	3	A	□【Electrical and Electronic Engineering】(EEE.C441)

		ENR.L442.L	★	VLSI Technology II	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.C442)
		ENR.L411.L	★	Fundamentals of Electronic Materials	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.D401)
		ENR.L412.L	★	Semiconductor Physics	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.D411)
		ENR.L443.L	★	Bipolar Transistors and Compound Semiconductor Devices	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.D451)
		ENR.L444.L		Advanced Power Semiconductor Devices	2-0-0	5	A	☐ 【Electrical and Electronic Engineering】(EEE.D481)
		ENR.L402.L		Utilization of Intelligent Information Resources and Patents	1-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.G401)
		ENR.L413.L		Electrical Modeling and Simulation	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.G411)
		ENR.L414.L	★	Electric Power and Motor Drive System Analysis	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.P401)
		ENR.L415.L	★	Advanced Course of Power Electronics	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.P411)
		ENR.L416.L	★	Advanced Electric Power Engineering	2-0-0	2,3	A	☐ 【Electrical and Electronic Engineering】(EEE.P421)
		ENR.L445.L	★	Plasma Engineering	2-0-0	3	A	☐ 【Electrical and Electronic Engineering】(EEE.P451)
		ENR.L446.L	★	Pulsed Power Technology	2-0-0	3,4,5	A	☐ 【Electrical and Electronic Engineering】(EEE.P461)
		ENR.L417.L	★	Advanced Electromagnetic Waves	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.S401)
		ENR.L447.L	★	Wireless Communication Engineering	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.S451)
		ENR.L448.L		Optical Communication Systems	2-0-0	3,5	A	☐ 【Electrical and Electronic Engineering】(EEE.S461)
		ENR.J438.L		Crystals Science	2-0-0	3	B	【Materials Science and Engineering】(MAT.C400)
		ENR.J439.L		Advanced Course of Dielectric and Ferroelectric Materials	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.C401)
		ENR.J440.L		Quantum Physics in Optical Response of Materials	2-0-0	3	B	【Materials Science and Engineering】(MAT.C402)
		ENR.J441.L		Advanced Course of Ceramic Thin Film Technology	2-0-0	3,4,5	B	【Materials Science and Engineering】(MAT.C403)
		ENR.J442.L		Physics and Chemistry of Semiconductors	2-0-0	1,3,5	B	【Materials Science and Engineering】(MAT.C404)
		ENR.J443.L		Advanced Course of Instrumental Analysis for Materials	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.C405)
		ENR.J444.L		Advanced Course of Magnetism	2-0-0	3,5	B	【Materials Science and Engineering】(MAT.C406)

		ENR.J410.L	★ O	Applied Diffraction Crystallography in Metals and Alloys	2-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.M401) O: English, E: Japanese
		ENR.J411.L	★	Characterization of Nanomaterials	2-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.M402)
		ENR.J412.L	★ O	Environmental Degradation of Materials	2-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.M403) O: English, E: Japanese
		ENR.J413.L	★ E	Transport Phenomena at High Temperature	2-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.M404) O: Japanese, E: English
		ENR.J414.L	★ E	Advanced Microstructure Design of Ferrous Materials	2-0-0	1,3,4	B	☐ 【Materials Science and Engineering】(MAT.M405) O: Japanese, E: English
		ENR.J415.L	★ O	Advanced Microstructure Design of Non-ferrous Materials	2-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.M406) O: English, E: Japanese
		ENR.J416.L	★ O	Advanced Solid State Physics	2-0-0	3,5	B	☐ 【Materials Science and Engineering】(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	☐ 【Materials Science and Engineering】(MAT.M408) O: Japanese, E: English
		ENR.J418.L	★ O	Thermodynamics for Phase Equilibria	2-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.M409) O: English, E: Japanese
		ENR.J419.L	★ O	Deformation and Strength of Solids	2-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.M410) O: English, E: Japanese
		ENR.J420.L	★ O	Phase Transformation and Microstructure Control	2-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.M411) O: English, E: Japanese
		ENR.J421.L		Organic Optical Materials physics	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P401)
		ENR.J422.L		Soft Materials Physical Chemistry	1-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.P402)
		ENR.J423.L	★	Soft Materials Physics	1-0-0	1,3	B	☐ 【Materials Science and Engineering】(MAT.P403)
		ENR.J424.L	★	Soft Materials Functional Physics	1-0-0	2,3	B	☐ 【Materials Science and Engineering】(MAT.P404)
		ENR.J425.L	★	Soft Materials Chemistry I	1-0-0		B	☐ 【Materials Science and Engineering】(MAT.P411)

		ENR.J426.L	★	Soft Materials Chemistry II	1-0-0		B	☐ 【Materials Science and Engineering】(MAT.P412)
		ENR.J427.L		Soft Materials Functional Chemistry	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P413)
		ENR.J428.L		Soft Materials Function	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P414)
		ENR.J429.L		Organic Materials Functional Design	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P421)
		ENR.J430.L		Organic Materials Design	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P422)
		ENR.J431.L		Advanced Course in Composite Materials	1-0-0	3	B	☐ 【Materials Science and Engineering】(MAT.P423)
		ENR.J432.L		Advanced Course in Polymer Processing A	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P424)
		ENR.J433.L		Advanced Course in Polymer Processing B	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.P425)
		ENR.J434.L		Materials Engineering and Ecology	1-0-0	2,4,5	B	☒ 【Materials Science and Engineering】(MAT.P491)
		ENR.J435.L		Advanced Course in Organic Polymer Science	1-0-0		B	☒ 【Materials Science and Engineering】(MAT.P492)
		ENR.H421.L		Advanced Electrochemistry I	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.A441)
		ENR.H422.L		Advanced Electrochemistry II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.A442)
		ENR.H423.L		Advanced Instrumental Analysis	1-0-0	3,5		☒ 【Chemical Science and Engineering】(CAP.A481)
		ENR.H451.L		Process Systems Engineering	2-0-0			☐ 【Chemical Science and Engineering】(CAP.C412)
		ENR.H452.L		Advanced Energy Transfer Operation	2-0-0	3,4,5		☐ 【Chemical Science and Engineering】(CAP.C421)
		ENR.H453.L		Advanced Chemical Reaction Engineering	2-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.C422)
		ENR.H454.L	★	Computational Fluid Dynamics	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.C423)
		ENR.H455.L		Physico-Chemical Property Analysis in Chemical Engineering	2-0-0	3,4		☐ 【Chemical Science and Engineering】(CAP.C432)
		ENR.H456.L	★	Transport Phenomena and Operation	2-0-0	1,3,4,5		☐ 【Chemical Science and Engineering】(CAP.C441)
		ENR.H457.L	★	Advanced Separation Operation	2-0-0	1,3		☐ 【Chemical Science and Engineering】(CAP.C442)
		ENR.H471.L		Advanced Coordination Chemistry	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.I403)
		ENR.H472.L		Environmental Chemistry	2-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.I405)

		ENR.H473.L		Introduction to Chemical Engineering 【Basics】	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.I407)
		ENR.H474.L		Advanced Supramolecular Chemistry	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.I413)
		ENR.H475.L		Environmental Analytical Chemistry	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.I415)
		ENR.H476.L		Catalysis for the Environmental Issues	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.I416)
		ENR.H477.L		Introduction to Chemical Engineering 【Unit Operation】	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.I417)
		ENR.H478.L		Advanced Organic Materials Chemistry	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.I423)
		ENR.H481.L	★	Advanced Nano-Materials Chemistry I	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.I434)
		ENR.H479.L		Geochemistry	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.I435)
		ENR.H482.L	★	Advanced Nano-Materials Chemistry II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.I444)
		ENR.H441.L		Advanced Polymer Synthesis I	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.P411)
		ENR.H442.L		Advanced Polymer Synthesis II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.P412)
		ENR.H443.L		Advanced Polymer Properties I	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.P421)
		ENR.H444.L		Advanced Polymer Properties II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.P422)
		ENR.H445.L		Advanced Polymer Structures I	1-0-0	3,4,5		☐ 【Chemical Science and Engineering】(CAP.P423)
		ENR.H446.L		Advanced Polymer Structures II	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.P424)
		ENR.H463.L		Introduction to Polymer Chemistry I	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.T401)
		ENR.H464.L		Introduction to Polymer Physics II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.T402)
		ENR.H465.L		Introduction to Polymer Chemistry II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.T403)
		ENR.H466.L		Introduction to Polymer Physics II	1-0-0	3		☐ 【Chemical Science and Engineering】(CAP.T404)
		ENR.H461.L		Advanced Organometallic Chemistry and Catalysis I	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.T431)
		ENR.H462.L		Advanced Organometallic Chemistry and Catalysis II	1-0-0	3,5		☐ 【Chemical Science and Engineering】(CAP.T432)
		ENR.B432.L	★	Technologies for Energy and Resource Utilization	1-0-0	1,2,3		☐ 【Global Engineering for Development】 (GEG.E404)

		ENR.B433.L	★	Project Design & Management S	0-1-1	1,2,5		【Global Engineering for Development】(GEG.P451)
		ENR.B434.L	★	Project Design & Management F	0-1-1	1,2,4,5		【Global Engineering for Development】(GEG.P452)
		ENR.B435.L	★	The economics and systems analysis of environment, resources and technology	1-0-0	3,4,5		【Global Engineering for Development】(GEG.S402)
		ENR.H447.L		Advanced Technology for Environmental Load Reduction I	1-0-0	1,3,5	A, C	□【ACEEES】(ACE.B441)
		ENR.H448.L		Advanced Technology for Environmental Load Reduction II	1-0-0	1,3,5	A, C	□【ACEEES】(ACE.B442)
	500 level	ENR.B501.L		Special lecture of economics and politics in energy	1-0-0	3,4,5	A, C	□
		ENR.H501.L	★	Advanced Chemical Materials for Energy Issues I	1-0-0	3,4,5	B	□
		ENR.H502.L	★	Advanced Chemical Materials for Energy Issues II	1-0-0	3,4,5	B	□
		ENR.H503.L	★	Advanced Polymer Design for Energy Materials	1-0-0	3,4,5	B	□
		ENR.I510.L		Optical properties of solids	2-0-0	3,4		□
		ENR.I520.L		Advanced Lecture on Crystal Structure and Correlation with Properties of Solids	1-0-0	3,5		□
		ENR.K530.L		Advanced course of multiscale thermal-fluid sciences	1-0-0	3	B	□
		ENR.K580.L	★	Leading edge energy technology	1-0-0	1,3	B	□
		ENR.L530.L	★	Advanced functional electron devices	2-0-0	1,2,3,4,5		□
		ENR.H523.L		Advanced Molecular Design for Organic Synthesis I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A521)
		ENR.H524.L		Advanced Molecular Design for Organic Synthesis II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A522)
		ENR.H555.L	★	Life Cycle Engineering	2-0-0	3,5	B	【Chemical Science and Engineering】(CAP.C511)
		ENR.I531.L		Advanced Separation Science	2-0-0		B	【Chemistry】(CHM.B531)
		ENR.I532.L		Global Environmental Chemistry	2-0-0	3	B	【Chemistry】(CHM.B532)
		ENR.I533.L		Catalytic Chemistry on Solid Surface	2-0-0	3	B	【Chemistry】(CHM.B533)
		ENR.I534.L		Advanced Course in Crystal Structure Science	2-0-0	3	B	【Chemistry】(CHM.B534)
		ENR.I535.L		Advanced Physical Chemistry	2-0-0		B	【Chemistry】(CHM.C531)
		ENR.I536.L		Advanced Quantum Chemistry	2-0-0	3	B	【Chemistry】(CHM.C532)
		ENR.I537.L		Advanced Organic Synthesis	2-0-0		B	【Chemistry】(CHM.D531)
		ENR.I538.L		Advanced Organometallic	2-0-0	3	B	【Chemistry】(CHM.D532)

			Chemistry				
ENR.I539.L			Advanced Bio-organic Chemistry	2-0-0	3	B	【Chemistry】(CHM.D533)
ENR.K501.L		★	Mechanics of High Temperature Materials	1-0-0	3,5	B	【Materials Science and Engineering】(MEC.C531)
ENR.K511.L			Experimental Model Analysis for Structural Dynamics	1-0-0	3,5	B	【Materials Science and Engineering】(MEC.D531)
ENR.K521.L		★	Plasma Physics	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MEC.E531)
ENR.K531.L		★	Flying Object Engineering	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MEC.F531)
ENR.K561.L			Rarefied Gas Dynamics	1-0-0	3,5	B	☐ 【Materials Science and Engineering】(MEC.F532)
ENR.K562.L			Precision Manufacturing Processes	1-0-0	3,5	B	【Materials Science and Engineering】(MEC.G531)
ENR.K571.L			Advanced Course of Micro and Nano Machining	1-0-0	3	B	【Materials Science and Engineering】(MEC.J532)
ENR.K572.L			Advanced Tribosystem	1-0-0	3	B	【Materials Science and Engineering】(MEC.J533)
ENR.K591.L		★	Space Systems Analysis B	1-0-0	3	B	【Materials Science and Engineering】(MEC.M531)
ENR.K592.L			Space Systems and Missions	2-0-0	3,4,5	B	【Materials Science and Engineering】(MEC.M532)
ENR.L501.L		★	Dielectric Property and Organic Devices	2-0-0	3	B	☐ 【Electrical and Electronic Engineering】(EEE.D501)
ENR.L511.L		★	Magnetism and Spintronics	2-0-0	3,5	B	☐ 【Electrical and Electronic Engineering】(EEE.D511)
ENR.L550.L			Nano-Structure Devices	2-0-0	3,5	B	☐ 【Electrical and Electronic Engineering】(EEE.D551)
ENR.L560.L		★	Terahertz Devices and Systems	2-0-0	3,4,5	B	☐ 【Electrical and Electronic Engineering】(EEE.D561)
ENR.L502.L		★	Magnetic Levitation and Magnetic Suspension	2-0-0	3	B	☐ 【Electrical and Electronic Engineering】(EEE.P501)
ENR.L512.L			Environment and Electric Energy	2-0-0	2,4,5	B	【Electrical and Electronic Engineering】(EEE.P511)
ENR.J501.L		★ O	Advanced Course of Materials Optics	2-0-0	3,5	B	☐ 【Materials Science and Engineering】(MAT.C500)
ENR.J502.L			Advanced Course of Deformation and Fracture of Engineering Materials	2-0-0	2,3,4,5	B	☐ 【Materials Science and Engineering】(MAT.C501)
ENR.J503.L			Advanced Course of Material Development I	2-0-0	3,5	B,C	【Materials Science and Engineering】(MAT.C502)
ENR.J504.L		★	Advanced Course of Material Development II	2-0-0	3	B,C	【Materials Science and Engineering】(MAT.C503)

		ENR.J505.L			Functional Devices	2-0-0	1,3	B	【Materials Science and Engineering】(MAT.C504)
		ENR.E521.L			Advanced Chemistry of Transition Metal Complexes I	1-0-0	3		☐ 【Chemical Science and Engineering】 (CAP.A561)
		ENR.E522.L			Advanced Chemistry of Transition Metal Complexes II	1-0-0	3		☐ 【Chemical Science and Engineering】 (CAP.A562)
		ENR.E551.L		★	Chemical Engineering in Global Business	1-0-0	1,2,3,5		【Chemical Science and Engineering】 (CAP.C521)
		ENR.E552.L		★	Advanced Chemical Equipment Design	2-0-0	3,5		☐ 【Chemical Science and Engineering】 (CAP.C531)
		ENR.E553.L		★	Advanced Specific Environmental Process	2-0-0	3,4		☐ 【Chemical Science and Engineering】 (CAP.C532)
		ENR.E554.L		★	Advanced Nanoscale Chemical Process	2-0-0	1,3,4,5		☐ 【Chemical Science and Engineering】 (CAP.C541)
		ENR.E571.L			Advanced Strategic Organic Synthesis	1-0-0	3		☐ 【Chemical Science and Engineering】 (CAP.I533)
		ENR.E572.L			Material Cycle Analysis	1-0-0	3,5		☐ 【Chemical Science and Engineering】 (CAP.I535)
		ENR.E573.L			Systematic Material Design Methodology	1-0-0	4,5		☐ 【Chemical Science and Engineering】 (CAP.I537)
		ENR.E574.L			Advanced Course in Macromolecular Materials I	1-0-0	3,5		☐ 【Chemical Science and Engineering】 (CAP.I539)
		ENR.E575.L		★	Advanced Process Dynamics and Control	1-0-0	3,5		☐ 【Chemical Science and Engineering】 (CAP.I547)
		ENR.E576.L			Advanced Course in Macromolecular Materials II	1-0-0	3,4,5		☐ 【Chemical Science and Engineering】 (CAP.I549)
		ENR.E541.L			Advanced Polymer Reactions	1-0-0	3,5		☐ 【Chemical Science and Engineering】 (CAP.P511)
		ENR.E542.L			Advanced Polymer Processing	1-0-0	3,4,5		☐ 【Chemical Science and Engineering】 (CAP.P581)
		ENR.E543.L		★	Advanced Polymer Science I	1-0-0	1,3,4,5		☐ 【Chemical Science and Engineering】 (CAP.P582)
		ENR.E544.L			Advanced Polymer Science II	1-0-0	1,3,5		☐ 【Chemical Science and Engineering】 (CAP.P583)
		ENR.E561.L			Advanced Catalytic Reactions I	1-0-0	3		☐ 【Chemical Science and Engineering】 (CAP.T531)
		ENR.E562.L			Advanced Catalytic Reactions II	1-0-0	3		☐ 【Chemical Science and Engineering】 (CAP.T532)

Note :

- ◎ : Required course, ○ : Restricted elective, O : odd academic years, E : even academic years, ★ : Classes in English
- ☐ : Course is recognized as an Academy for Co-creative Education of Environment and Energy Science, Leading Graduate School (ACEES) course.
- Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = Practical and/or problem-solving skills

- [] Course offered under 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 Engineering Courses), 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 Recognized as Humanities and Social Science Courses

None

7. IGP Courses That Can be Recognized as Career Development Courses

As a general rule, students who would like their Career Development Courses to contribute to completion requirements of their master's degree program need to satisfy all of the specified Graduate Attributes ("GA"), including the attainment of at least two course credits, listed in Table MA-1 of the "Guide to Graduate Education and International Graduate Program (Liberal Arts and Basic Science Courses) - Career Development Courses". The status of the GA will be evaluated at the time of degree completion.

In addition to Career Development Courses, there are Major Courses that can also be recognized as such — shown below in Table M3 — which may go toward fulfilling the GA requirements.

However, note that when the corresponding Major Courses are recognized and accredited as Career Development Courses, their credits cannot be counted a second time (as Major Courses) towards degree completion requirements.

Table M3. Courses of the Graduate Major in Energy Science and Engineering that can be recognized as Career Development Courses

Career Development Courses								
Course Category	Course Number	Course			Credits	GA*	Learning goals	Comments
can be recognized as Career Development Courses	CAP.E521			Scientific Ethics	1-0-0	C0M	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E422			Presentation Practice	0-1-0	C1M	E	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E411			Advanced Internship in Chemical Science and Engineering I	0-0-1	C1M	D	For Students belonging to Dept. of Chemical Science and Engineering

	CAP.E412			Advanced Internship in Chemical Science and Engineering II	0-0-2	C1M	D	For Students belonging to Dept. of Chemical Science and Engineering
	CHM.A461			Presentation Exercises in Chemistry	0-1-0	C0M	C,E	For Students belonging to Dept. of Chemistry
	CHM.A462			Introductory Exercises in Chemistry	0-1-0	C1M	C,E	For Students belonging to Dept. of Chemistry
	MEC.R431			Off-campus Project M1c	0-0-1	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.R432			Off-campus Project M2c	0-0-2	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.R433			Off-campus Project M3c	0-0-3	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.R434			Off-campus Project M4c	0-0-4	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.S431			Overseas Research Project M1c	0-0-1	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.S432			Overseas Research Project M2c	0-0-2	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.S433			Overseas Research Project M3c	0-0-3	C1M		For Students belonging to Dept. of Mechanical Engineering
	MEC.S434			Overseas Research Project M4c	0-0-4	C1M		For Students belonging to Dept. of Mechanical Engineering
	MAT.A460			Off-campus Project in Materials Engineering A1	0-0-1	C1M	B,D	For Students belonging to Dept. of Materials Science and Engineering
	MAT.A461			Off-campus Project in Materials Engineering A2	0-0-2	C1M	B,D	For Students belonging to Dept. of Materials Science and Engineering
	MAT.A462			Off-campus Project in Materials Engineering B1	0-0-1	C1M	B,D	For Students belonging to Dept. of Materials Science and Engineering

	MAT.A463			Off-campus Project in Materials Engineering B2	0-0-2	C1M	B,D	For Students belonging to Dept. of Materials Science and Engineering
	EEE.R561			Internship (Master Course) A	0-0-1	C1M	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R562			Internship (Master Course) B	0-0-2	C1M	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R563			Internship (Master Course) C	0-0-4	C1M	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R564			Internship (Master Course) D	0-0-6	C1M	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.G401			Utilization of Intelligent Information Resources and Patents	1-0-0	C1M	B,E	For Students belonging to Dept. of Electrical and Electronic Engineering
To satisfy the Career Development requirement, credits may be acquired from courses listed above as well as from those listed under Career Development Courses (see the Liberal Arts and Basic Science Courses Guide). *GA : Graduate Attribute								

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

Required Courses

Elective Courses

1①

1②

1③

1④

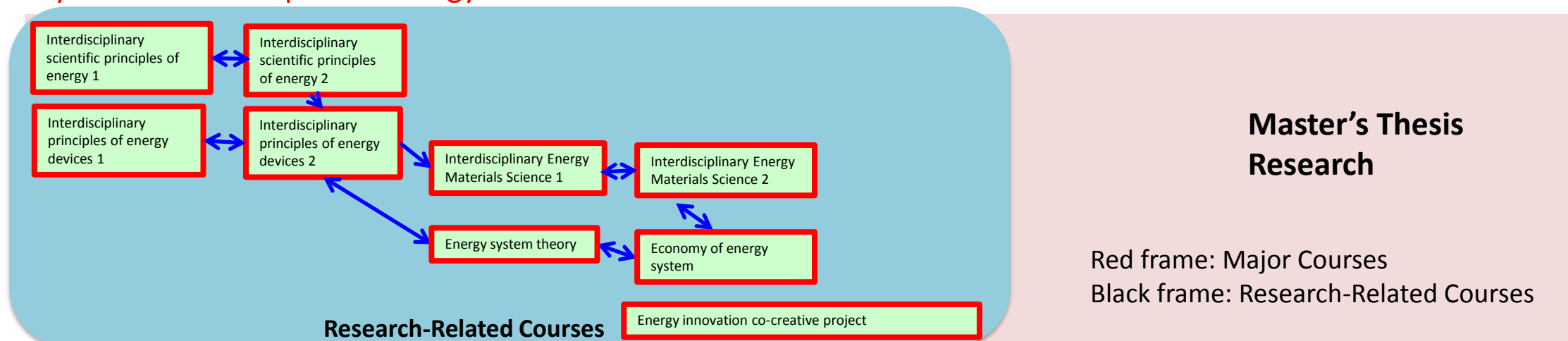
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2②

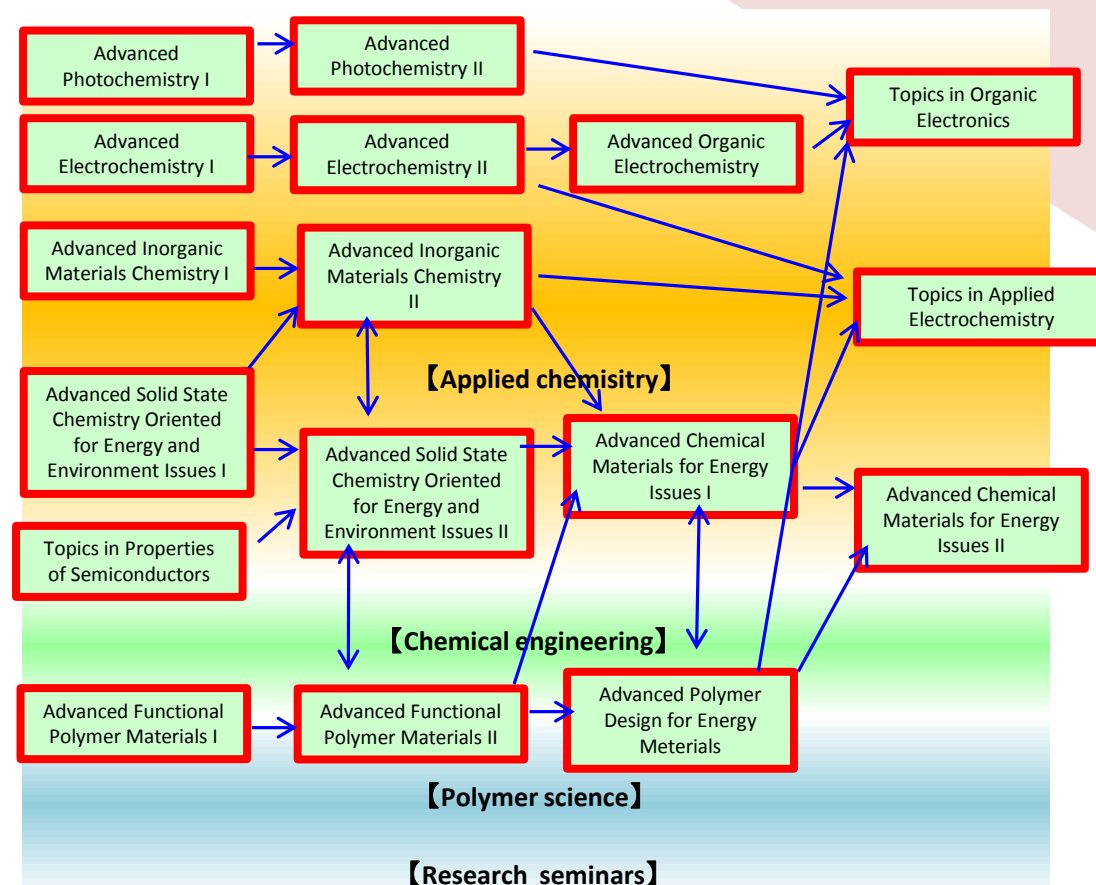
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2④

Interdisciplinary Scientific Principles of Energy 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 Organometallic Chemistry and Catalysis I
Advanced Coordination Chemistry	Material Cycle Analysis	Advanced Nano-Materials Chemistry I	Advanced Catalytic Reactions II	Advanced Electrochemistry I
Environmental Analytical Chemistry	Advanced Instrumental Analysis	Advanced Nano-Materials Chemistry II	Advanced Organometallic Chemistry and Catalysis II	Advanced Electrochemistry II
Catalysis for the Environmental Issues	Advanced Supramolecular 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 Separation 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

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

Elective Courses

1①

1②

1③

1④

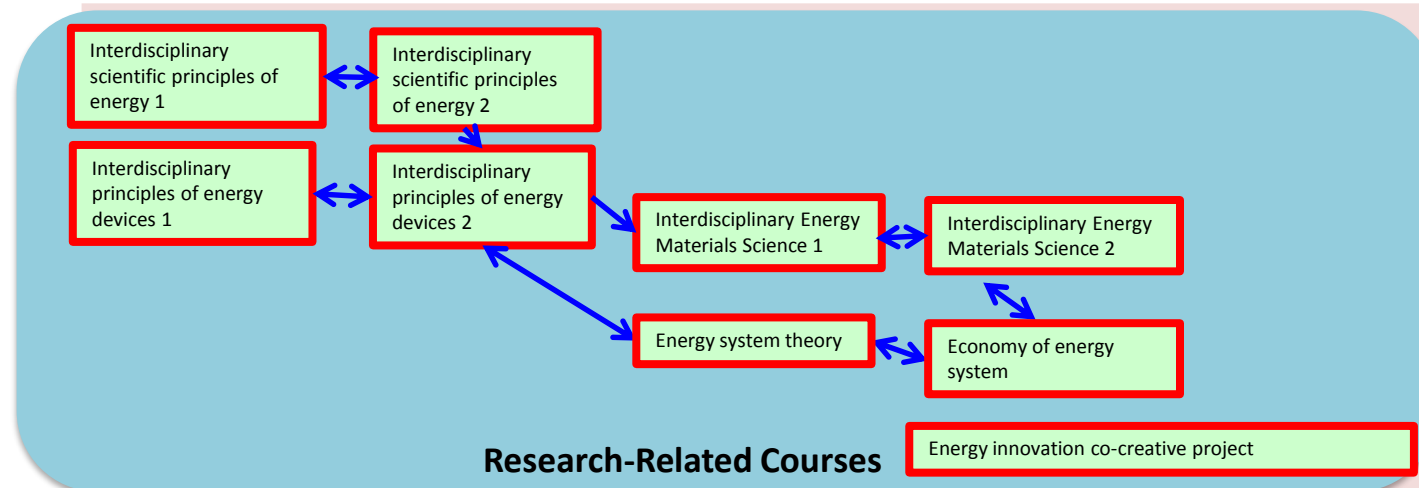
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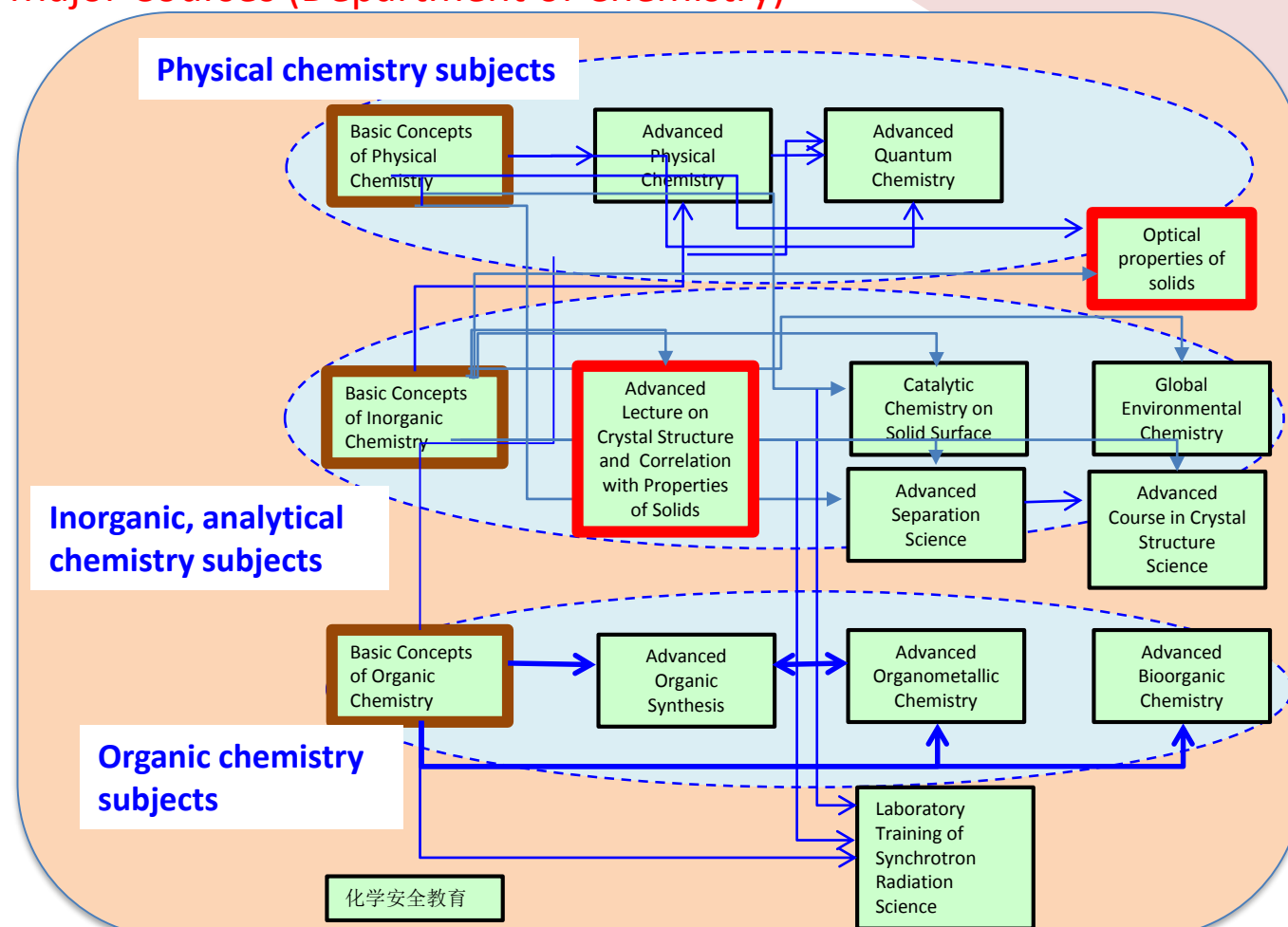
2④

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 course (recommended)

Research Seminars

Seminar in energy science S1

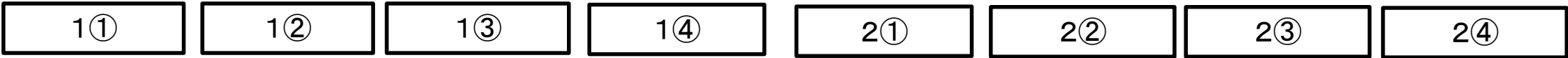
Seminar in energy science F1

Seminar in energy science S2

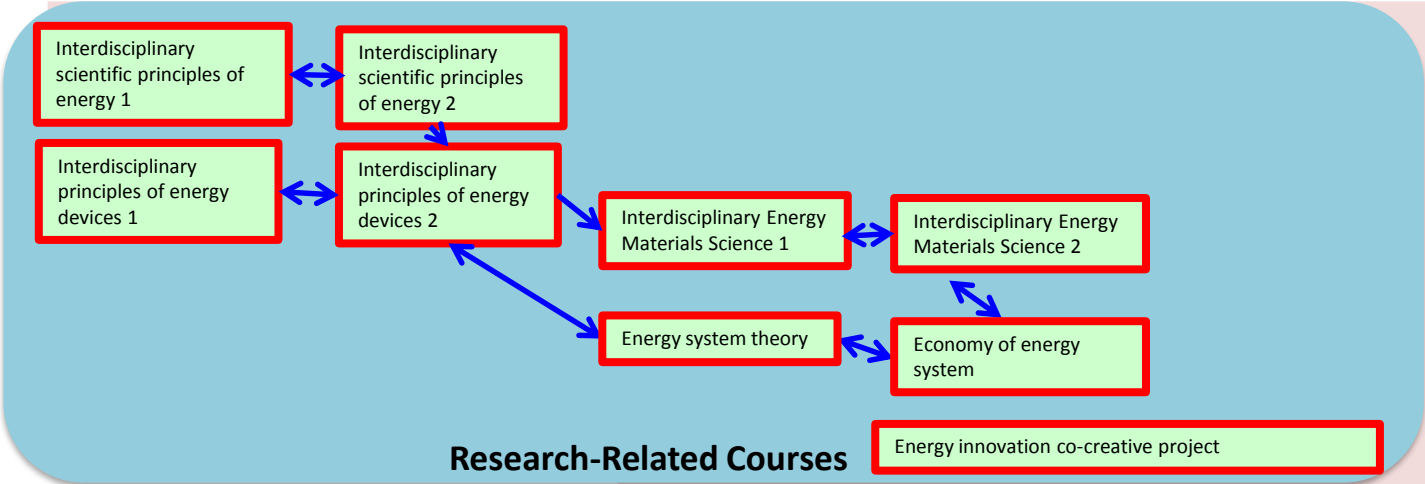
Seminar in energy science F2

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

Required Courses Elective Courses



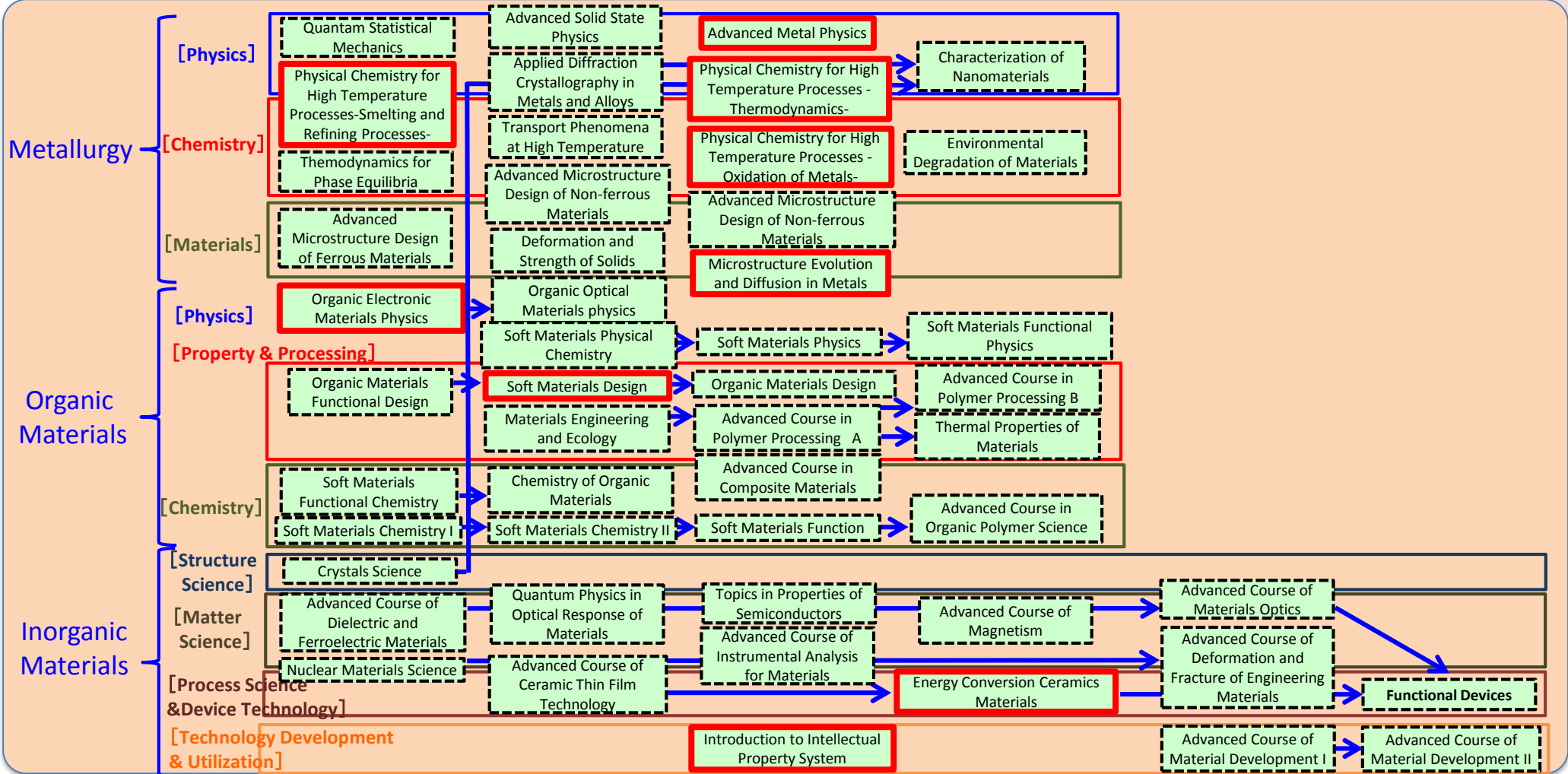
Interdisciplinary Scientific Principles of Energy Courses



Master’s Thesis
Research

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

Major Courses (Department of Materials Science and Engineering)



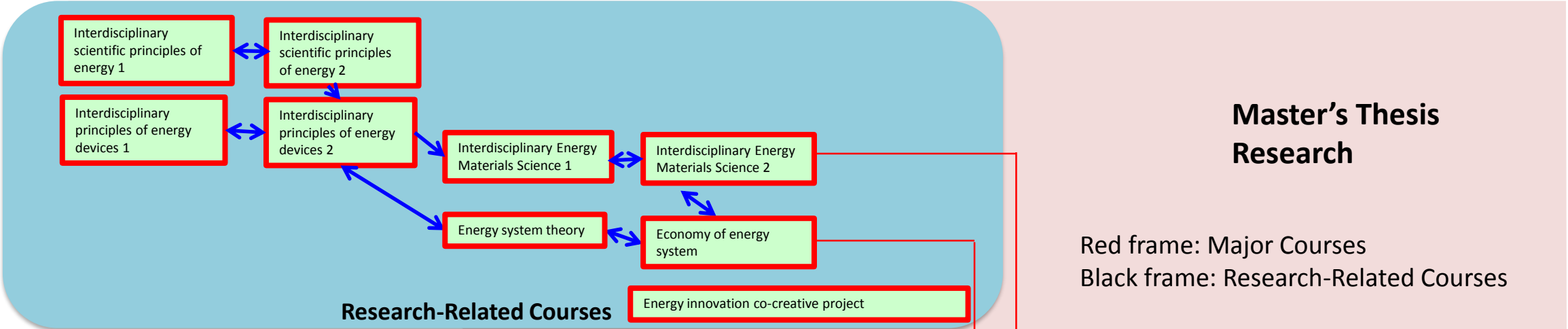
【Department of Electrical and Electronic Engineering,
Graduate Major of Energy Science and Engineering (Master’s program) 】

Required Courses

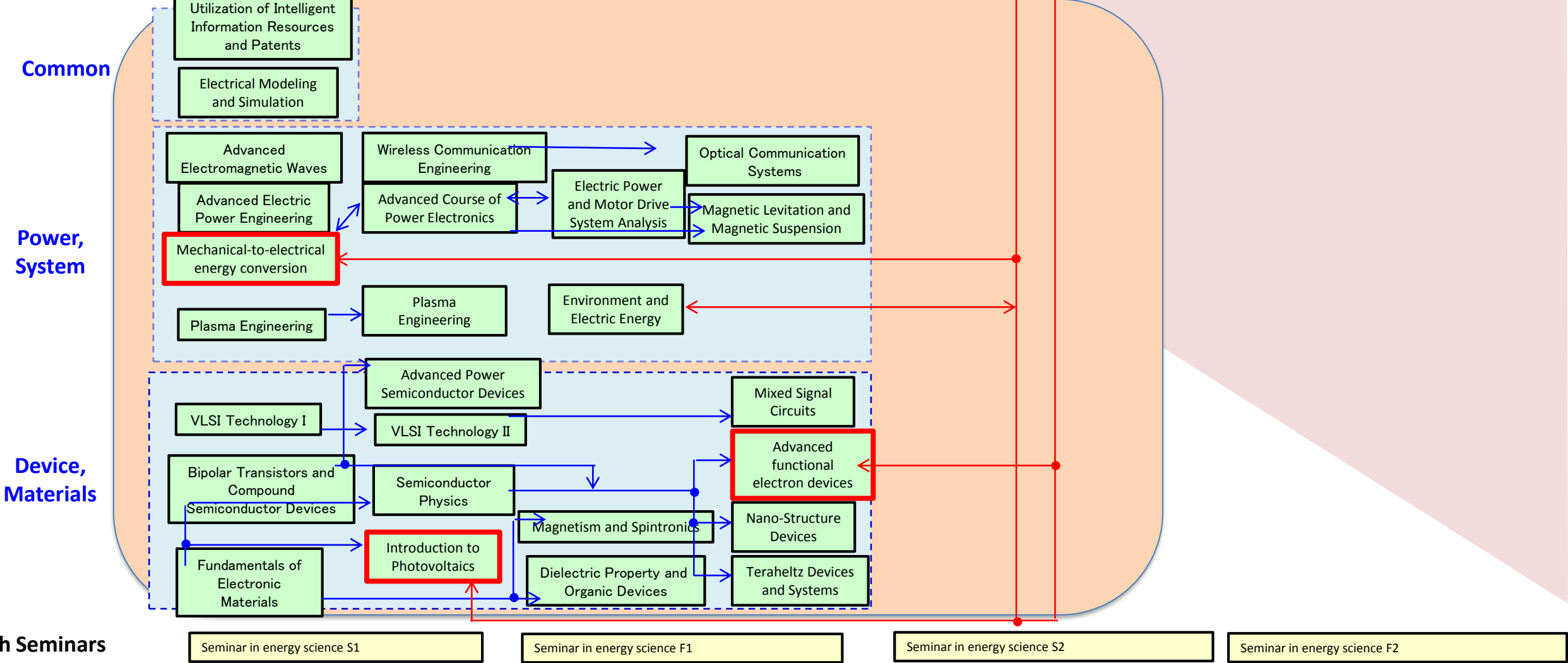
Elective Courses

- 1①
- 1②
- 1③
- 1④
- 2①
- 2②
- 2③
- 2④

Interdisciplinary Scientific Principles of Energy Courses



Major Courses (Department of Electrical and Electronic Engineering)



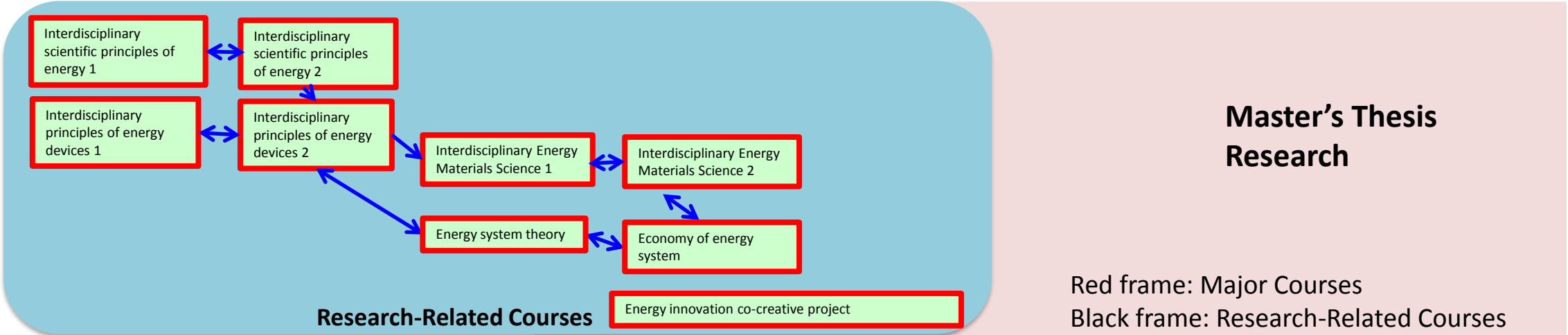
【Department of Mechanical Engineering,
Graduate Major of Energy Science and Engineering (Master's program) 】

Required Courses

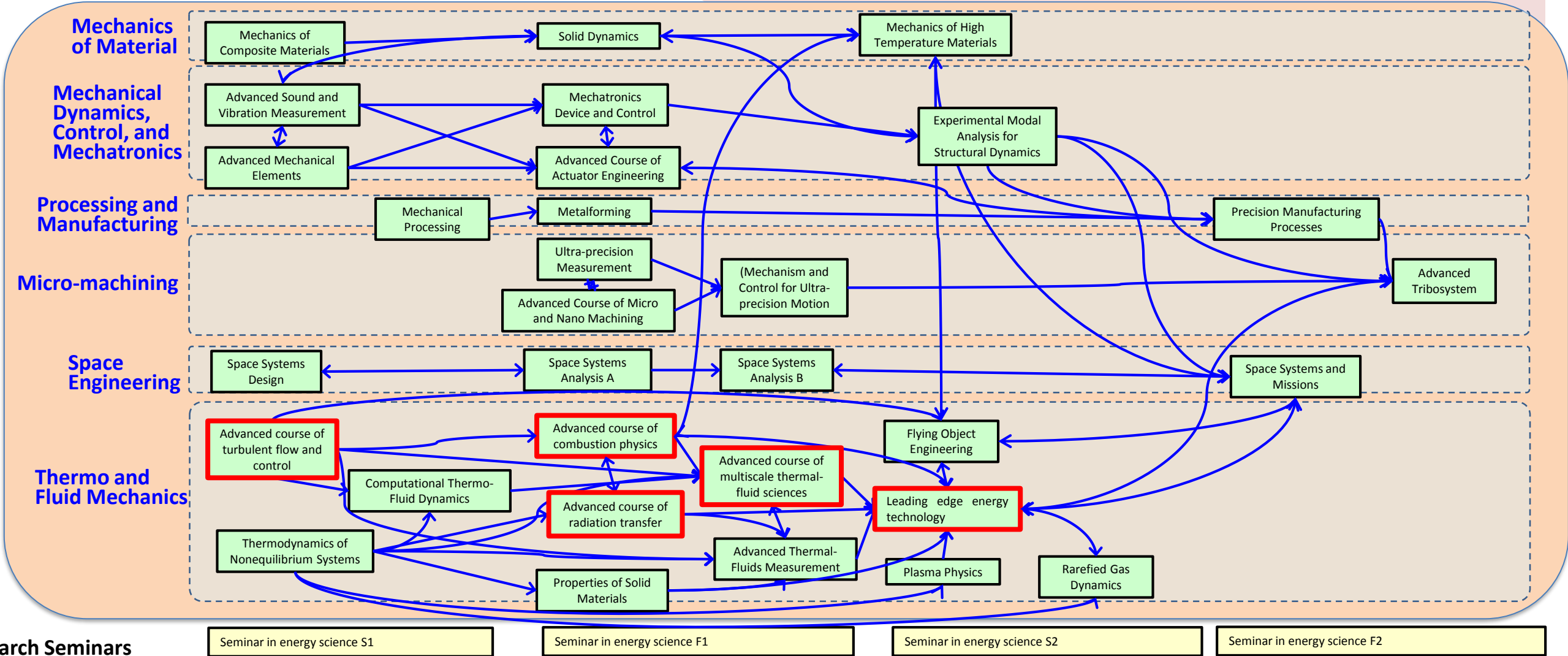
Elective Courses



Interdisciplinary Scientific Principles of Energy Courses



Major Courses (Department of Mechanical Engineering)



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

Required Courses

Elective Courses

1①

1②

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1④

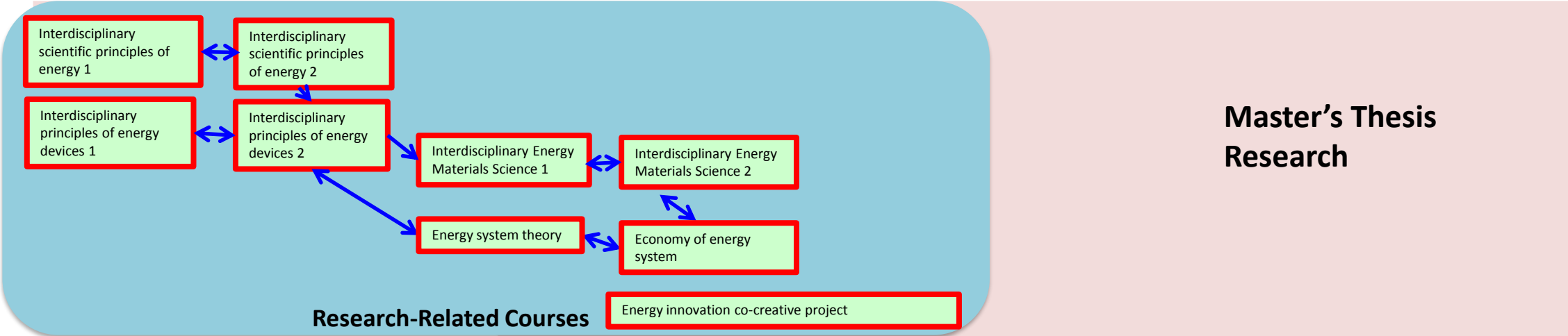
2①

2②

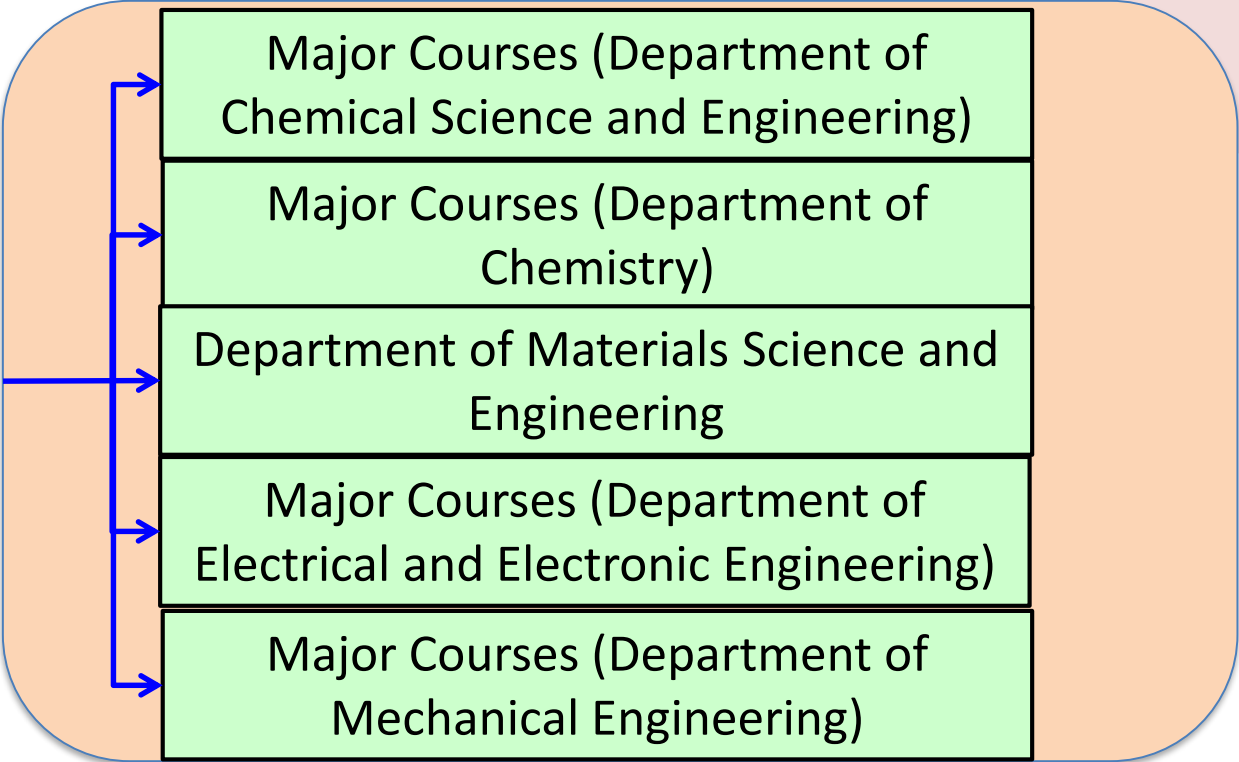
2③

2④

Interdisciplinary Scientific Principles of Energy Courses



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

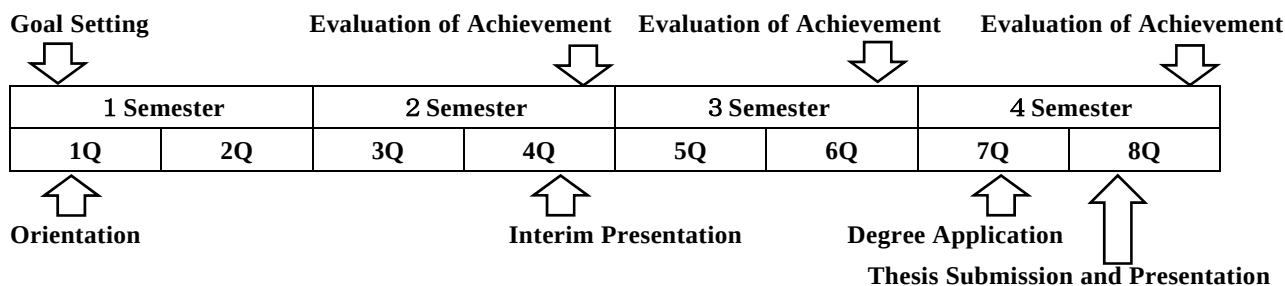
Seminar in energy science F1

Seminar in energy science S2

Seminar in energy science F2

Research Related to the Completion of Master Theses

The master's thesis research aims to acquire the abilities to identify and to solve new issues and communication skills through research. The typical procedure of the master's thesis research is shown as follows. The learning achievement will be evaluated by the candidate's supervisor. The candidate will consider his or her study plan based on goals and progress of the master's thesis research as necessary.



- 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.

【Doctoral Degree Program】

1. Outline

To integrate and reorganize the complicated 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 organized knowledge in the field of energy science and engineering and to lead a cutting-edge research and development with the societal responsibilities and the ethics as well as the 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 organized knowledge in the field of energy science and engineering.
- Ability to conduct innovative research and development in an ethical manner.
- Management and 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 the problems and the way to solve the problems by integrating their original discipline chemistry, applied chemistry, material science, mechanical engineering, or electrical engineering with other energy-related disciplines.

C) Ability to create issues

Students are requested to acquire the ability to create issues 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 communication skills through discussions with expert scientists in the domestic and international community.

4. IGP Completion Requirements

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

1. A total of 24 credits or more acquired 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;
 - Minimum of 6 credits acquired from Major Courses; and
 - Minimum of 6 credits acquired from Liberal Arts and Basic Science Courses
(2 credits from the 600-level Humanities and Social Sciences Courses, and 4 credits from Career Development Courses).
3. Pass the doctoral thesis review and defense.

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	
	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	
Total required credits		A minimum of 24 credits in addition to meeting the above conditions				
Note		• Japanese Language and Culture Courses offered to International Students can be recognized as Humanities and Social Science Courses of the corresponding course level. • As for Liberal Arts and Basic Science Courses, please refer to the relevant pages.				

P Courses

Table D2. Core Courses of the Graduate Major in Energy Science and Engineering

Course category		Course number	Course			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.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	
		ENR.E611.L	L	★	Academic Writing B	1-0-0	1,2,4	A,C,E	
		ENR.E612.L	L	★	International energy project	0-0-2	1,2,4,5	C,D,E	
Note :									
• ⊙ : Required course, L : Elective course									
• Competencies: 1 = Intercultural skills; 2 = Communication skills; 3 = Specialist skills; 4 = Critical thinking skills; 5 = Practical and/o									

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 Recognized as Humanities and Social Science Courses

None

7. IGP Courses That Can be Recognized as Career Development Courses

As a general rule, students who would like their Career Development Courses to contribute to completion requirements of their doctoral degree program need to satisfy all of the specified Graduate Attributes ("GA"), including the attainment of at least four course credits, listed in Table A-1 or A-2 of the "Guide to Graduate Education and International Graduate Program (Liberal Arts and Basic Science Courses) - Career Development Courses". The status of the GA will be evaluated at the time of degree completion.

In addition to Career Development Courses, there are Major Courses that can also be recognized as such — shown below in Table D3-1 or D3-2 — which may go toward fulfilling the GA requirements.

However, note that when the corresponding Major Courses are recognized and accredited as Career Development Courses, their credits cannot be counted a second time (as Major Courses) towards degree completion requirements.

Table D3-1. Courses of the Graduate Major in Energy Science and Engineering that can be recognized as Career Development Courses of Academic Leader Program (ALP)

Course category	Course Number	Course			credits	GA*	Learning objectives	Comments
are recognized as Career Development Courses	CAP.E631			Chemical Science and Engineering Off-Campus Project 1	0-0-1	A1D, A2D, A3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E632			Chemical Science and Engineering Off-Campus Project 2	0-0-2	A1D, A2D, A3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E633			Chemical Science and Engineering Off-Campus Project 3	0-0-4	A1D, A2D, A3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E634			Chemical Science and Engineering Off-Campus Project 4	0-0-6	A1D, A2D, A3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CHM.A661		★	Basic Exercises in Global Presentation	0-1-0	A1D A2D	C,D,E	For Students belonging to Dept. of Chemistry

	CHM.A662		★ Advanced Exercises in Global Presentation	0-1-0	A2D A3D	C,D,E	For Students belonging to Dept. of Chemistry
	CHM.A651		Laboratory Training of Advanced Chemistry I	0-1-0	A2D A3D	D,E	For Students belonging to Dept. of Chemistry
	CHM.A652		Laboratory Training of Advanced Chemistry II	0-1-0	A2D A3D	D,E	For Students belonging to Dept. of Chemistry
	CHM.A653		Laboratory Training of Advanced Chemistry III	0-1-0	A2D A3D	D,E	For Students belonging to Dept. of Chemistry
	CHM.A654		Laboratory Training of Advanced Chemistry IV	0-1-0	A2D A3D	D,E	For Students belonging to Dept. of Chemistry
	MEC.T631		Teaching Practice in Mechanical Engineering	0-0-2	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.R631		Off Campus Project D1c	0-0-1	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.R632		Off Campus Project D2c	0-0-2	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.R633		Off Campus Project D3c	0-0-3	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.R634		Off Campus Project D4c	0-0-4	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.R635		Off Campus Project D5c	0-0-5	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.R636		Off Campus Project D6c	0-0-6	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.S631		Overseas Research Project D1c	0-0-1	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.S632		Overseas Research Project D2c	0-0-2	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.S633		Overseas Research Project D3c	0-0-3	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.S634		Overseas Research Project D4c	0-0-4	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MEC.S635		Overseas Research Project D5c	0-0-5	A2D		For Students belonging to

					A3D		Dept. of Mechanical Engineering
	MEC.S636		Overseas Research Project D6c	0-0-6	A2D A3D		For Students belonging to Dept. of Mechanical Engineering
	MAT.A661		Materials Off-campus Project 1	0-0-1	A1D A2D A3D	D	For Students belonging to Dept. of Materials Science and Engineering
	MAT.A662		Materials Off-campus Project 2	0-0-2	A1D A2D A3D	D	For Students belonging to Dept. of Materials Science and Engineering
	MAT.A663		Materials Off-campus Project 3	0-0-4	A1D A2D A3D	D	For Students belonging to Dept. of Materials Science and Engineering
	MAT.A664		Materials Off-campus Project 4	0-0-6	A1D A2D A3D	D	For Students belonging to Dept. of Materials Science and Engineering
	EEE.G601		Teaching Skills in English for Doctoral Course Students	0-1-0	A1D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R611		Doctor Course Colloquium	0-1-0	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R621		International Presentations	0-1-0	A2D A3D	B,C,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R601		Training on Teaching Technique	0-1-0	A1D A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R651		Study Abroad (Doctor Course) A	0-0-1	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R652		Study Abroad (Doctor Course) B	0-0-2	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R653		Study Abroad (Doctor Course) C	0-0-4	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R654		Study Abroad (Doctor Course) D	0-0-6	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R661		Internship (Doctor Course) A	0-0-1	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering

	EEE.R662			Internship (Doctor Course) B	0-0-2	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R663			Internship (Doctor Course) C	0-0-4	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
	EEE.R664			Internship (Doctor Course) D	0-0-6	A2D A3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
To satisfy the Career Development requirement, credits may be acquired from courses listed above as well as from those listed under Career Development Courses (see the Liberal Arts and Basic Science Courses Guide). *GA : Graduate Attribute								

Table D3-2. Courses of the Graduate Major in Energy Science and Engineering that can be recognized as Career Development Courses of Productive Leader Program (PLP)

Course category	Course Number	Course		credits	GA*	Learning Objectives	Comments	
are recognized as Career Development Courses	CAP.E631			Chemical Science and Engineering Off-Campus Project 1	0-0-1	P1D, P2D, P3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E632			Chemical Science and Engineering Off-Campus Project 2	0-0-2	P1D, P2D, P3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E633			Chemical Science and Engineering Off-Campus Project 3	0-0-4	P1D, P2D, P3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CAP.E634			Chemical Science and Engineering Off-Campus Project 4	0-0-6	P1D, P2D, P3D	D	For Students belonging to Dept. of Chemical Science and Engineering
	CHM.A661		★	Basic Exercises in Global Presentation	0-1-0	P1D P2D	C,D,E	For Students belonging to Dept. of Chemistry
	CHM.A662		★	Advanced Exercises in Global Presentation	0-1-0	P2D P3D	C,D,E	For Students belonging to Dept. of Chemistry
	CHM.A651			Laboratory Training of Advanced Chemistry I	0-1-0	P2D P3D	D,E	For Students belonging to Dept. of Chemistry
	CHM.A652			Laboratory Training of Advanced Chemistry II	0-1-0	P2D P3D	D,E	For Students belonging to Dept. of Chemistry
	CHM.A653			Laboratory Training of Advanced Chemistry III	0-1-0	P2D P3D	D,E	For Students belonging to Dept. of Chemistry
	CHM.A654			Laboratory Training of Advanced Chemistry IV	0-1-0	P2D P3D	D,E	For Students belonging to Dept. of Chemistry
	MEC.R631			Off Campus Project D1c	0-0-1	P2D P3D		For Students belonging to Dept. of Mechanical

							Engineering
MEC.R632			Off Campus Project D2c	0-0-2	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.R633			Off Campus Project D3c	0-0-3	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.R634			Off Campus Project D4c	0-0-4	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.R635			Off Campus Project D5c	0-0-5	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.R636			Off Campus Project D6c	0-0-6	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.S631			Overseas Research Project D1c	0-0-1	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.S632			Overseas Research Project D2c	0-0-2	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.S633			Overseas Research Project D3c	0-0-3	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.S634			Overseas Research Project D4c	0-0-4	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.S635			Overseas Research Project D5c	0-0-5	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MEC.S636			Overseas Research Project D6c	0-0-6	P2D P3D		For Students belonging to Dept. of Mechanical Engineering
MAT.A661			Materials Off-campus Project 1	0-0-1	P1D P2D P3D	D	For Students belonging to Dept. of Materials Science and Engineering
MAT.A662			Materials Off-campus Project 2	0-0-2	P1D P2D P3D	D	For Students belonging to Dept. of Materials Science and Engineering
MAT.A663			Materials Off-campus Project 3	0-0-4	P1D P2D P3D	D	For Students belonging to Dept. of Materials Science and Engineering
MAT.A664			Materials Off-campus Project 4	0-0-6	P1D	D	For Students belonging to

					P2D P3D		Dept. of Materials Science and Engineering
EEE.R611			Doctor Course Colloquium	0-1-0	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R621			International Presentations	0-1-0	P2D P3D	B,C,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R651			Study Abroad (Doctor Course) A	0-0-1	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R652			Study Abroad (Doctor Course) B	0-0-2	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R653			Study Abroad (Doctor Course) C	0-0-4	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R654			Study Abroad (Doctor Course) D	0-0-6	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R661			Internship (Doctor Course) A	0-0-1	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R662			Internship (Doctor Course) B	0-0-2	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R663			Internship (Doctor Course) C	0-0-4	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering
EEE.R664			Internship (Doctor Course) D	0-0-6	P2D P3D	B,D,E	For Students belonging to Dept. of Electrical and Electronic Engineering

To satisfy the Career Development requirement, credits may be acquired from courses listed above as well as from those listed under Career Development Courses (see the Liberal Arts and Basic Science Courses Guide).

***GA : Graduate Attribute**

【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

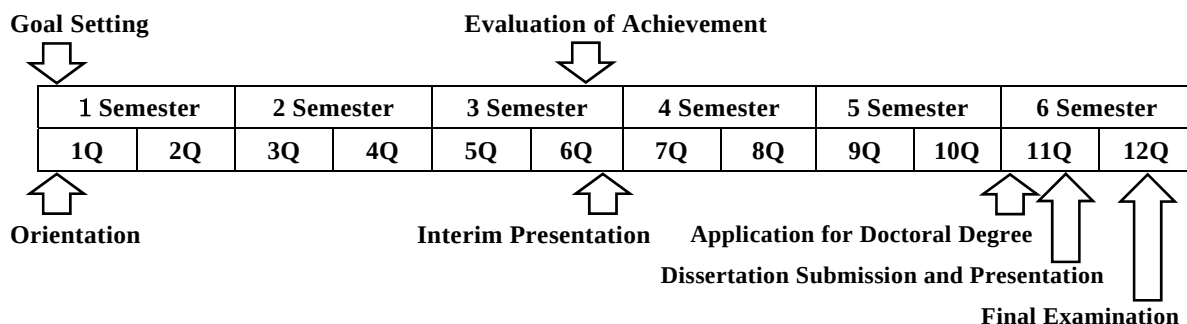
- Academic WritingA
- Academic WritingB1
- International scientific presentation A
- Practical research in energy science A
- International scientific presentation B
- Practical research in energy science B

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

Research Related to the Completion of Doctoral Theses

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 and evaluation of the achievement. The typical procedure of the doctoral dissertation research is shown as follows.



- Screening Criteria for Doctoral Dissertation

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

- Screening of Doctoral Dissertation

The Screening Committee shall consist of multiple examiners who can evaluate the dissertation from an academic and a technological 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 reviewing the dissertation by examiners. Oral presentation must be carried out in English or Japanese.