

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.

5. MS 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	<input type="checkbox"/>
		ENR.Z492.R	⊙	Seminar in energy science F1	0-0-2	2,3,4,5	A,B,C	<input type="checkbox"/>
	500 level	ENR.Z591.R	⊙	Seminar in energy science S2	0-0-2	2,3,4,5	A,B,C	<input type="checkbox"/>
		ENR.Z592.R	⊙	Seminar in energy science F2	0-0-2	2,3,4,5	A,B,C	<input type="checkbox"/>
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	<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.E421)
		ENR.E495.L		Presentation Practice	0-1-0	2,5	E or BD	<input type="checkbox"/> 【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	<input type="checkbox"/>
		ENR.H591.L		Scientific Ethics	1-0-0	3,5	D or BD	<input type="checkbox"/> 【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	<input type="checkbox"/>
		ENR.A402.A	○	Interdisciplinary scientific principles of energy 2	1-0-0	3,4,5	A, C	<input type="checkbox"/>
		ENR.A403.A	○	Interdisciplinary principles of energy devices 1	1-0-0	3,5	A, C	<input type="checkbox"/>

ENR.A404.A	○		Interdisciplinary principles of energy devices 2	1-0-0	3,4,5	A, C	<input type="checkbox"/>
ENR.A405.A	○		Interdisciplinary Energy Materials Science 1	1-0-0	3,4,5	A, C	<input type="checkbox"/>
ENR.A406.A	○		Interdisciplinary Energy Materials Science 2	1-0-0	3,4,5	A, C	<input type="checkbox"/>
ENR.A407.A	○		Energy system theory	1-0-0		A, C	<input type="checkbox"/>
ENR.A408.A	○		Economy of energy system	1-0-0	3,4,5	A, C	<input type="checkbox"/>
ENR.B430.L			Advanced Science and Technology in Energy and Environment	2-0-0	3,5	A, C	<input type="checkbox"/>
ENR.B431.L		★	Recent technologies of fuel cells, solar cells, batteries and energy system	2-0-0	1,2,3,4,5	A, C	<input type="checkbox"/> 【SGU summer program】
ENR.H401.L			Advanced Photochemistry I	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H402.L			Advanced Photochemistry II	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H403.L			Advanced Electrochemistry I	1-0-0	3	B	<input type="checkbox"/>
ENR.H404.L			Advanced Electrochemistry II	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H405.L			Advanced Inorganic Materials Chemistry I	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H406.L			Advanced Inorganic Materials Chemistry II	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H407.L			Advanced Solid State Chemistry Oriented for Energy and Environment Issues I	1-0-0	3,4,5	B	<input type="checkbox"/>
ENR.H408.L			Advanced Solid State Chemistry Oriented for Energy and Environment Issues II	1-0-0	3,4,5	B	<input type="checkbox"/>
ENR.H409.L			Topics in Organic Electronics	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H410.L			Topics in Properties of Semiconductors	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H411.L			Topics in Applied Electrochemistry	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H412.L			Advanced Organic Electrochemistry	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H413.L			Advanced Functional Polymer Materials I	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H414.L			Advanced Functional Polymer Materials II	1-0-0	3,5	B	<input type="checkbox"/>
ENR.H416.L		★ ○	Advanced Electrochemistry	2-0-0		B	
ENR.H417.L		★ ○	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.H437.L		★	Fundamentals of Industrial Catalysis	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A456)
ENR.H438.L		★	Role of Catalysis in Biomass Utilization and Recycling of Plastics Wastes	1-0-0	3	B	【Chemical Science and Engineering】(CAP.A457)
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 I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A422)
ENR.H428.L			Advanced Organic Synthesis I	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A423)
ENR.H429.L			Advanced Organic Synthesis II	1-0-0	3,5	B	【Chemical Science and Engineering】(CAP.A424)
ENR.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)
ENR.H483.L		★ O	Coordination Chemistry	2-0-0		B	【Chemical Science and Engineering】(CAP.I471)
ENR.H484.L		★ O	Advanced Catalytic Chemistry	2-0-0	3	B	【Chemical Science and Engineering】(CAP.I472)
ENR.H485.L		★ E	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	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.C411)
ENR.L441.L		VLSI Technology I	2-0-0	3	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.C441)
ENR.L442.L	★	VLSI Technology II	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.C442)
ENR.L411.L	★	Fundamentals of Electronic Materials	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.D401)
ENR.L412.L	★	Semiconductor Physics	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.D411)
ENR.L443.L	★	Bipolar Transistors and Compound Semiconductor Devices	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.D451)
ENR.L444.L		Advanced Power Semiconductor Devices	2-0-0	5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.D481)
ENR.L402.L		Utilization of Intelligent Information Resources and Patents	1-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.G401)
ENR.L413.L		Electrical Modeling and Simulation	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.G411)
ENR.L414.L	★	Electric Power and Motor Drive System Analysis	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.P401)
ENR.L415.L	★	Advanced Course of Power Electronics	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.P411)
ENR.L416.L	★	Advanced Electric Power Engineering	2-0-0	2,3	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.P421)
ENR.L445.L	★	Plasma Engineering	2-0-0	3	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.P451)
ENR.L446.L	★	Pulsed Power Technology	2-0-0	3,4,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.P461)
ENR.L417.L	★	Advanced Electromagnetic Waves	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.S401)
ENR.L447.L	★	Wireless Communication Engineering	2-0-0	3,5	A	<input type="checkbox"/> 【Electrical and Electronic Engineering】(EEE.S451)
ENR.L448.L		Optical Communication Systems	2-0-0	3,5	A	<input type="checkbox"/> 【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	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M401) O: English, E: Japanese
ENR.J411.L		★	Characterization of Nanomaterials	2-0-0	3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M402)
ENR.J412.L		★ O	Environmental Degradation of Materials	2-0-0	3	B	<input type="checkbox"/> 【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	<input type="checkbox"/> 【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	<input type="checkbox"/> 【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	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M406) O: English, E: Japanese
ENR.J416.L		★ O	Advanced Solid State Physics	2-0-0	3,5	B	<input type="checkbox"/> 【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	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M408) O: Japanese, E: English
ENR.J418.L		★ O	Thermodynamics for Phase Equilibria	2-0-0	3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M409) O: English, E: Japanese
ENR.J419.L		★ O	Deformation and Strength of Solids	2-0-0	3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M410) O: English, E: Japanese
ENR.J420.L		★ O	Phase Transformation and Microstructure Control	2-0-0	3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.M411) O: English, E: Japanese
ENR.J421.L			Organic Optical Materials physics	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P401)
ENR.J422.L			Soft Materials Physical Chemistry	1-0-0	3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P402)
ENR.J423.L		★	Soft Materials Physics	1-0-0	1,3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P403)

ENR.J424.L		★	Soft Materials Functional Physics	1-0-0	2,3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P404)
ENR.J425.L		★	Soft Materials Chemistry I	1-0-0		B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P411)
ENR.J426.L		★	Soft Materials Chemistry II	1-0-0		B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P412)
ENR.J427.L			Soft Materials Functional Chemistry	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P413)
ENR.J428.L			Soft Materials Function	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P414)
ENR.J429.L			Organic Materials Functional Design	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P421)
ENR.J430.L			Organic Materials Design	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P422)
ENR.J431.L			Advanced Course in Composite Materials	1-0-0	3	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P423)
ENR.J432.L			Advanced Course in Polymer Processing A	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P424)
ENR.J433.L			Advanced Course in Polymer Processing B	1-0-0	3,5	B	<input type="checkbox"/> 【Materials Science and Engineering】(MAT.P425)
ENR.J434.L			Materials Engineering and Ecology	1-0-0	2,4,5	B	<input checked="" type="checkbox"/> 【Materials Science and Engineering】(MAT.P491)
ENR.J435.L			Advanced Course in Organic Polymer Science	1-0-0		B	<input checked="" type="checkbox"/> 【Materials Science and Engineering】(MAT.P492)
ENR.H421.L			Advanced Electrochemistry I	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.A441)
ENR.H422.L			Advanced Electrochemistry II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.A442)
ENR.H423.L			Advanced Instrumental Analysis	1-0-0	3,5		<input checked="" type="checkbox"/> 【Chemical Science and Engineering】(CAP.A481)
ENR.H451.L			Process Systems Engineering	2-0-0			<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C412)
ENR.H452.L			Advanced Energy Transfer Operation	2-0-0	3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C421)
ENR.H453.L			Advanced Chemical Reaction Engineering	2-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C422)
ENR.H454.L		★	Computational Fluid Dynamics	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C423)
ENR.H455.L			Physico-Chemical Property Analysis in Chemical Engineering	2-0-0	3,4		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C432)
ENR.H456.L		★	Transport Phenomena and Operation	2-0-0	1,3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C441)
ENR.H457.L		★	Advanced Separation Operation	2-0-0	1,3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.C442)

ENR.H471.L			Advanced Coordination Chemistry	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I403)
ENR.H472.L			Environmental Chemistry	2-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I405)
ENR.H473.L			Introduction to Chemical Engineering 【Basics】	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I407)
ENR.H474.L			Advanced Supramolecular Chemistry	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I413)
ENR.H475.L			Environmental Analytical Chemistry	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I415)
ENR.H476.L			Catalysis for the Environmental Issues	1-0-0	3		<input checked="" type="checkbox"/> 【Chemical Science and Engineering】(CAP.I416)
ENR.H477.L			Introduction to Chemical Engineering 【Unit Operation】	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I417)
ENR.H478.L			Advanced Organic Materials Chemistry	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I423)
ENR.H481.L		★	Advanced Nano-Materials Chemistry I	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I434)
ENR.H479.L			Geochemistry	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I435)
ENR.H482.L		★	Advanced Nano-Materials Chemistry II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.I444)
ENR.H441.L			Advanced Polymer Synthesis I	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.P411)
ENR.H442.L			Advanced Polymer Synthesis II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.P412)
ENR.H443.L			Advanced Polymer Properties I	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.P421)
ENR.H444.L			Advanced Polymer Properties II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.P422)
ENR.H445.L			Advanced Polymer Structures I	1-0-0	3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.P423)
ENR.H446.L			Advanced Polymer Structures II	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.P424)
ENR.H463.L			Introduction to Polymer Chemistry I	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.T401)
ENR.H464.L			Introduction to Polymer Physics II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.T402)
ENR.H465.L			Introduction to Polymer Chemistry II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.T403)
ENR.H466.L			Introduction to Polymer Physics II	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.T404)
ENR.H461.L			Advanced Organometallic Chemistry and Catalysis I	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】(CAP.T431)

	ENR.H462.L		Advanced Organometallic Chemistry and Catalysis II	1-0-0	3,5		<input type="checkbox"/> 【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	<input type="checkbox"/> 【ACEEES】(ACE.B441)
	ENR.H448.L		Advanced Technology for Environmental Load Reduction II	1-0-0	1,3,5	A, C	<input type="checkbox"/> 【ACEEES】(ACE.B442)
500 level	ENR.B501.L		Special lecture of economics and politics in energy	1-0-0	3,4,5	A, C	<input type="checkbox"/>
	ENR.H501.L	★	Advanced Chemical Materials for Energy Issues I	1-0-0	3,4,5	B	<input type="checkbox"/>
	ENR.H502.L	★	Advanced Chemical Materials for Energy Issues II	1-0-0	3,4,5	B	<input type="checkbox"/>
	ENR.H503.L	★	Advanced Polymer Design for Energy Materials	1-0-0	3,4,5	B	<input type="checkbox"/>
	ENR.I510.L		Optical properties of solids	2-0-0	3,4		<input type="checkbox"/>
	ENR.I520.L		Advanced Lecture on Crystal Structure and Correlation with Properties of Solids	1-0-0	3,5		<input type="checkbox"/>
	ENR.K530.L		Advanced course of multiscale thermal-fluid sciences	1-0-0	3	B	<input type="checkbox"/>
	ENR.K580.L	★	Leading edge energy technology	1-0-0	1,3	B	<input type="checkbox"/>
	ENR.L530.L	★	Advanced functional electron devices	2-0-0	1,2,3,4,5		<input type="checkbox"/>
	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 Chemistry	2-0-0	3	B	【Chemistry】(CHM.D532)
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		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.A561)
ENR.E522.L			Advanced Chemistry of Transition Metal Complexes II	1-0-0	3		<input type="checkbox"/> 【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		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.C531)
ENR.E553.L		★	Advanced Specific Environmental Process	2-0-0	3,4		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.C532)
ENR.E554.L		★	Advanced Nanoscale Chemical Process	2-0-0	1,3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.C541)
ENR.E571.L			Advanced Strategic Organic Synthesis	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.I533)
ENR.E572.L			Material Cycle Analysis	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.I535)
ENR.E573.L			Systematic Material Design Methodology	1-0-0	4,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.I537)
ENR.E574.L			Advanced Course in Macromolecular Materials I	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.I539)
ENR.E575.L		★	Advanced Process Dynamics and Control	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.I547)
ENR.E576.L			Advanced Course in Macromolecular Materials II	1-0-0	3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.I549)
ENR.E541.L			Advanced Polymer Reactions	1-0-0	3,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.P511)
ENR.E542.L			Advanced Polymer Processing	1-0-0	3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.P581)
ENR.E543.L		★	Advanced Polymer Science I	1-0-0	1,3,4,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.P582)
ENR.E544.L			Advanced Polymer Science II	1-0-0	1,3,5		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.P583)
ENR.E561.L			Advanced Catalytic Reactions I	1-0-0	3		<input type="checkbox"/> 【Chemical Science and Engineering】 (CAP.T531)
ENR.E562.L			Advanced Catalytic Reactions II	1-0-0	3		<input type="checkbox"/> 【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 (ACEEES) 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. Courses That Can be Recognized as Humanities and Social Science Courses

None

7. 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

Course Category	Course Number	Course	Credits	GA*	Learning goals	Comments
can be recognized as Career Development Courses	CAP.E521	Scientific Ethics	1-0-0	COM	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

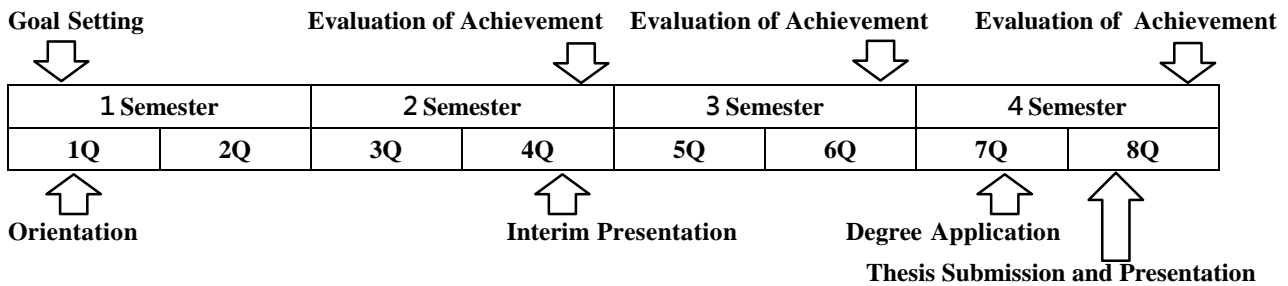
	MAT.A462			Off-campus Project in Materials Engineering B1	0-0-1	C1M	B,D	For Students belonging to Dept. of Materials Science and Engineering
	MAT.A463			Off-campus Project in Materials Engineering B2	0-0-2	C1M	B,D	For Students belonging to Dept. of Materials Science and Engineering
	EEE.R561			Internship (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**

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.

5. Doctoral 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	
Research-related 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/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. Courses That Can be Recognized as Humanities and Social Science Courses

None

7. 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**

