Graduate Major in Energy Science and Informatics

【Master's Degree Program】

1. Outline

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

The Master's Degree Program, for Graduate Major in the Energy Science and Informatics provides students highly technical knowledge based on fundamental disciplines such as physics, chemistry, mechanical engineering, electrical and electronic engineering, materials science, applied chemistry, computer science, and transdisciplinary science. In addition, this major provides students various skills for evaluating diverse energy-related issues from the viewpoint of multidisciplinary energy science as well as energy-related big data science, fact-finding, problem solving, and global leadership, which are necessary for the innovation in a sustainable society.

The goals of human resource development in the Master's Degree Program of Energy Science and Informatics course are as follows: Students acquire advanced academic knowledge in their own specialized fields, and by acquiring the Multi-dimensional Energy theory (Interdisciplinary Principles of Energy) that is the academic basis of energy studies common to the Energy Science and Informatics fields, they develop the ability to view a wide range of energy-related issues from a bird's-eye view. In addition, students acquire the ability to apply energy big data science to their own research and development, the social vision to plan and design projects by explaining the social significance of one's own research and development, and the ability to independently identify and solve problems. It is surely expected that students will be able to demonstrate international leadership and to drive innovation with a strong desire to contribute to the society in the future.

2. Learning Objectives (Competencies Developed)

The students acquire,

- High level of technical knowledge and specialized academic ability in one's expertise field disciplines (i.e., physics, chemistry, applied chemistry, materials science, mechanical engineering, electrical and electronic engineering, energy based economics, computer science, transdisciplinary Science)
- Specialized academic ability in the Multi-dimensional Energy theory to understand diverse energy-related topics
- Ability to concretely utilize artificial intelligence analysis and data science to apply for one's own energy-related field of expertise
- Ability based on social science knowledge and skills, to envision society and explain the social and economic value of the one's own on-going research and development projects
- Ability to proactively challenge facing new problems, and problem solving skills
- Internationally applicable technical communication skills and global leadership skills

3. Learning Goals

The students enrolled in Energy Science and Informatics course learn,

A) Fundamental knowledge in the field of Energy Science and Informatics

A wide variety of energy related courses provides students to develop the fundamental academic skills required to understand a wide range of knowledge related to energy, as well as the basic academic skills related to the energy field (Multi-dimensional Energy theory and Energy Big Data Science).

B) Advanced knowledge in the field of Energy Science and Informatics

A wide variety of coursework provides students to develop deep specialized academic ability, and application skills necessary to understand and utilize knowledge from a wide range of fields related to energy, as well as deep specialized academic ability in the field of energy (Multi-dimensional Energy theory and Energy Big Data Science).

C) Development for a broad perspective interdisciplinary view, problem-solving ability, and social envision ability, in energy and informatics field

This course aims to develop leadership and social envision skills to involve others in one's own ideas by taking a broad view of various knowledge related to energy, extracting essential issues and solving problems, and explaining the social and economic significance of energy.

D) Development for the ability to conduct research safely while understanding ethical standards as a researcher

This course aims to develop the ability to promote research and development safely as a researcher while maintaining a responsibility and a high sense of ethics in interactions with society.

E) Acquisition and improvement of communication skills

This course aims to develop communication skills that enable students to exchange opinions accurately and develop logical discussions with those from various specialties fields.

4. IGP Completion Requirements

The following requirements must be met to complete the Master's Degree Program of this major.

1. Attain a total of 30 or more credits from 400- and 500-level courses.
2. From the courses specified in the Graduate Major in Energy Science and Informatics curriculum below,
   - A minimum of 21 credits acquired from major courses and research seminars
   - A minimum of 4 credits from “Interdisciplinary Principles of Energy Courses (A) (ESI.A400.A: Required elective)”
     Note: For students of Computer Science, at least a minimum of 2 credits from the Interdisciplinary Principles of Energy Courses (A) (ESI.A400.A), and it is allowed to take additional credits from the Interdisciplinary Principles of Energy Courses (B) (ESI.B400.L: elective) for fulfilling a minimum of 4 credits.
   - A minimum of 2 credits from “Energy Big Data Science Courses ((ESI.D400.L: elective)”
   - A minimum of 4 credits from the major courses in the student’s department.
     Note: For students of the Department of Chemistry, a minimum of 4 credits from the Chemistry Major Courses with marked (*), and for students of the Department of Transdisciplinary Science and Engineering, a minimum of 4 credits from the major courses in all the departments (either one or more) that offer Graduate Major in Energy Science and Informatics.
   - 8 credits acquired from “Research Seminars” (Seminar in energy science Spring semester in the 1st year (S1), Fall semester 1st year (F1), Spring 2nd Year (S2), and Fall 2nd Year (F2)); and
   - A minimum of 5 credits acquired from Liberal Arts and Basic Science Courses (3 credits from Humanities and Social Science Courses of which 2 credits must be from 400-level courses and 1 credit from 500-level courses, and 2 credits

from Entrepreneurship Courses including both GAM0 and GAM1).

3. Pass the master's thesis exam and oral defense.

Table M1 shows course categories and the number of credits required to complete the Master's Degree Program in this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as “associated learning objectives”. Prior to registering courses, students need to fully understand the course goals.

Table M1. Graduate Major in Energy Science and Informatics Completion Requirements

Course category		<Required courses> Required credits	<Electives> Minimum credits required	Minimum credits required	Associated learning goals	Comments
Liberal arts and basic science courses	**Humanities and social science courses**		2 credits from 400-level 1 credit from 500-level	5 credits	D	
	Entrepreneurship Courses		2 credits from 400- and 500-levels		C,D,E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	**Research seminars**	Seminar in Energy Science and Informatics S1 Seminar in Energy Science and Informatics F1 Seminar in Energy Science and Informatics S2 Seminar in Energy Science and Informatics F2 A total of 8 credits, 2 credits each from above courses.		21 credits	B,C,D,E	
	Research-related courses				B,C,D,E	
	Major courses		a minimum of 4 credits from "Interdisciplinary Principles of Energy Courses (A)", For students of Computer Science, at least a minimum of 2 credits from the Interdisciplinary Principles of Energy Courses (A), and it is allowed to take additional credits from the Interdisciplinary Principles of Energy Courses (B) for fulfilling a required minimum of 4 credits, and a minimum of 2 credits from "Energy Big Data Science Courses", and a minimum of 4 credits from the Major Courses in the student's department.		A,B	

			For students in Department of Chemistry, a minimum of 4 credits from the Chemistry major courses (*), and for students in the Department of Transdisciplinary Science and Engineering, a minimum of 4 credits from the major courses in all the departments (either one or more) that offer Graduate Major in Energy Science and Informatics.			
	Major courses and Research-related Courses <u>outside</u> the Graduate Major in Energy Science Engineering standard curriculum					
Total required credits		**A minimum of 30 credits including those attained according to the above conditions**				
Note		**・Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level. ・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections. ・For students in the Department of Chemistry, a minimum of 4 credits must come from the Chemistry Course Track marked with '(*)'.**				

5. IGP Courses

Table M2 shows the Core Courses of the Master's Degree Program in this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

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

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	400 level	ESI.Z491.R	◎		Seminar in energy science and informatics S1	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z492.R	◎		Seminar in energy science and informatics F1	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
	500 level	ESI.Z591.R	◎		Seminar in energy science and informatics S2	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z592.R	◎		Seminar in energy science and informatics F2	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
Research-related courses	400 level	ESI.E496			Environment Preservation and Chemical Safety	1-0-0	1,5	B	【Chemical Science and Engineering】 (CAP.E462) Chemical Science and Engineering Course Track
		ESI.E493.L			Advanced Internship in Chemical Science and Engineering I	0-0-1	2,3,5	B,D	【Chemical Science and Engineering】 (CAP.E411) Chemical Science and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
		ESI.E494.L			Advanced Internship in Chemical Science and Engineering II	0-0-2	2,3,5	B,D	【Chemical Science and Engineering】 (CAP.E412) Chemical Science and Engineering

									Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
		ESI.E495.L			Presentation Practice	0-1-0	3,5	E or B,D	【Chemical Science and Engineering】 (CAP.E422) Chemical Science and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
	500 level	ESI.B502.L			Energy innovation co-creative project	0-0-1	1,2,3,4,5	A,C,E	
		ESI.B503			Energy Informatics Internship A	0-0-1	2,3,5	C,D,E	Course outside the standard curriculum
		ESI.B504			Energy Informatics Internship B	0-0-2	2,3,5	C,D,E	Course outside the standard curriculum
		ESI.H591.L		★	Researcher Ethics and Engineer Ethics	1-0-0	1,3,5	D or B,D	【Chemical Science and Engineering】 (CAP.E521) Chemical Science and Engineering Course Track (for students affiliated with the Department of Chemical Science and Engineering only)
		ESI.B511.L		★	Energy Informatics Off-Campus Project S A	0-0-1	1,5	B,C,E	
		ESI.B512.L		★	Energy Informatics Off-Campus Project S B	0-0-1	1,5	B,C,E	
		ESI.B513.L		★	Energy Informatics Off-Campus Project S C	0-0-1	1,5	B,C,E	
		ESI.B514.L		★	Energy Informatics Off-Campus Project S D	0-0-1	1,5	B,C,E	
		ESI.B515.L		★	Energy Informatics Off-Campus Project L A	0-0-2	1,3,5	B,C,E	

		ESI.B516.L		★	Energy Informatics Off-Campus Project L B	0-0-2	1,3,5	B,C,E	
		ESI.B517.L		★	Energy Informatics Off-Campus Project L C	0-0-2	1,3,5	B,C,E	
		ESI.B518.L		★	Energy Informatics Off-Campus Project L D	0-0-2	1,3,5	B,C,E	
		ESI.B519.L		★	Energy Informatics International Workshop A	0-0-1	1,3	C,E	
		ESI.B520.L		★	Energy Informatics International Workshop B	0-0-1	1,3	C,E	
		ESI.B521.L		★	Energy Informatics International Workshop C	0-0-1	1,3	C,E	
		ESI.B522.L		★	Energy Informatics International Workshop D	0-0-1	1,3	C,E	
Major courses	**400 level**	Interdisciplinary Principles of Energy Courses 400 Level							
		ESI.A401.A	○	★	Interdisciplinary scientific principles of energy 1	1-0-0	1,4,5	A,C	
		ESI.A402.A	○	★	Interdisciplinary scientific principles of energy 2	1-0-0	1,4,5	A,C	
		ESI.A403.A	○	★	Interdisciplinary principles of energy devices 1	1-0-0	1,5	A,C	
		ESI.A404.A	○	★	Interdisciplinary principles of energy devices 2	1-0-0	1,4,5	A,C	
		ESI.A405.A	○	★	Interdisciplinary Energy Materials Science 1	1-0-0	1,4,5	A,C	
		ESI.A406.A	○	★	Interdisciplinary Energy Materials Science 2	1-0-0	1,4,5	A,C	
		ESI.A407.A	○	★	Energy system theory	1-0-0	1,4	A,C	
		ESI.A408.A	○	★	Economy of energy system	1-0-0	1,4,5	A,C	
		ESI.B430.L			Advanced Science and Technology in Energy and Environment	2-0-0	1,5	A,C	
		ESI.B431.L		★	Recent technologies of fuel cells, solar cells, batteries and energy system	1-0-0	1,2,3,4,5	A,C	Open also to Tokyo Tech Summer Program participants
		ESI.B436.L			Special lecture of economics and politics in energy	1-0-0	1,4,5	A,C	
		ESI.B437.L		★	Energy & Environment-1	1-0-0	1,5	A,B,E	【Global

									Engineering for Development, Environment and Society】(GEG.E421) Open also to Tokyo Tech Summer Program participants Not offered in AY 2024
		ESI.B438.L		★	Materials simulation	2-0-0	1,5	B	【Tokyo Tech Academy for Convergence of Materials and Informatics】(TCM.A402)
		ESI.B440.L		★	Materials Informatics	2-0-0	1,5	B	【Tokyo Tech Academy for Convergence of Materials and Informatics】(TCM.A404)
		ESI.B450.L		★	Marketing for Value Creation	1-0-0	1,4,5	B	【Tokyo Tech Academy of Energy and Informatics Program】(ENI.H401)
		ESI.B451.L		★	Finance and Data Analysis in Energy Markets	1-0-0	1,4,5	B	【Tokyo Tech Academy of Energy and Informatics Program】(ENI.H402)
		ESI.B452.L		★	Economic Development and Energy Policies	1-0-0	1,4,5	B	【Tokyo Tech Academy of Energy and Informatics Program】(ENI.H403)
		ESI.B460			Ota City Start-up Experience Off-Campus Project	0.5-0-0.5	3,4,5	B,C,E	【Tokyo Tech Academy of Energy and Informatics Program】(SSS.S433)
		Energy Big Data Science Courses 400 Level							

		ESI.D401.L		★	Big Data in Energy: a practical introduction	0-1-0			【Tokyo Tech Academy of Energy and Informatics Program】(ENI.I401)（Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.D402.L		★ 3E 4J	Fundamentals of Data Science	1-0-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO.T487）
		ESI.D403.L			Exercises in Fundamentals of Data Science	0-1-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO.T488）
		ESI.D404.L		★ 3E 4J	Fundamentals of Artificial Intelligence	1-0-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO.T489）
		ESI.D405.L			Exercises in Fundamentals of Artificial Intelligence	0-1-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO.T490）
		ESI.D406.L			Applied Practical Data Science and Artificial Intelligence 3A	1-0-0			【Center of Data Science and Artificial Intelligence】（DSA.P421）

		ESI.D407.L			Applied Practical Science and Artificial Intelligence 2A	1-0-0			【Center of Data Science and Artificial Intelligence】（DSA.P421）
		ESI.D408.L			Applied Practical Data Science and Artificial Intelligence 1A	1-0-0			【Center of Data Science and Artificial Intelligence】（DSA.P411）
		ESI.D409.L			Applied Practical Data Science and Artificial Intelligence 2B	1-0-0			【Center of Data Science and Artificial Intelligence】（DSA.P422）
		ESI.D410.L			Advanced Course in Crystal Structure Science	2-0-0	1	B	【Chemistry】(CHM.B434)
		Energy Big Data Science Courses 500 Level							
		ESI.D501.L		★	Advanced Artificial Intelligence	2-0-0			【Artificial Intelligence】（ART.T548）
		Chemistry Course Track 400 Level							
		ESI.I401.L		★	(*)Basic Concepts of Inorganic Chemistry I	1-0-0	1	A	【Chemistry】(CHM.B401)
		ESI.I404.L		★	(*)Basic Concepts of Inorganic Chemistry Ⅱ	1-0-0	1	A	【Chemistry】(CHM.B402)
		ESI.I402.L		★	(*)Basic Concepts of Physical Chemistry Ⅰ	1-0-0	1	A	【Chemistry】(CHM.C401)
		ESI.I405.L		★	(*)Basic Concepts of Physical ChemistrⅡ	1-0-0	1	A	【Chemistry】(CHM.C402)
		ESI.I403.L		★	(*)Basic Concepts of Organic Chemistry Ⅰ	1-0-0	1	A	【Chemistry】(CHM.D401)
		ESI.I406.L		★	(*)Basic Concepts of Organic Chemistry Ⅱ	1-0-0	1	A	【Chemistry】(CHM.D402)
		ESI.I410.L		★	Optical properties of solids	2-0-0	1,4	B	
		ESI.I411.L		★	Advanced Coordination Chemistry I	1-0-0	1,3		【Chemistry】（CHM.B438）
		ESI.I412.L		★	Advanced Coordination Chemistry II	1-0-0	1,3		【Chemistry】（CHM.B439）
		ESI.I413.L		★	Advanced Physical Chemistry I	1-0-0	1,3		【Chemistry】（CHM.C433）

		ESI.I414.L		★	Advanced Physical Chemistry II	1-0-0	1,3		【Chemistry】(CHM.C434)
		ESI.I415.L		★	Advanced Quantum Chemistry I	1-0-0	1,3		【Chemistry】(CHM.C435)
		ESI.I416.L		★	Advanced Quantum Chemistry II	1-0-0	1,3		【Chemistry】(CHM.C436)
		ESI.I417.L		★	Advanced Material Chemistry I	1-0-0	1,3		【Chemistry】(CHM.C437)
		ESI.I418.L		★	Advanced Material Chemistry II	1-0-0	1,3		【Chemistry】(CHM.C438)
		ESI.I420.L		★	Advanced Lecture on Crystal Structure and Correlation with Properties of Solids	1-0-0	1,5	B	
		ESI.I422.L			Global Environmental Chemistry	2-0-0	1	B	【Chemistry】(CHM.B435)
		ESI.I425.L		★	Advanced Organic Synthesis	2-0-0	1,5	B	【Chemistry】(CHM.D432)
		ESI.I426.L		★	Advanced Organometallic Chemistry	2-0-0	1	B	【Chemistry】(CHM.D433)
		ESI.I427.L		★	Photochemical Reactions I	1-0-0	1	B	【Chemistry】(CHM.B436) Only available for students who have taken this course during their bachelor's program
		ESI.I428.L		★	Photochemical Reactions II	1-0-0	1	B	【Chemistry】(CHM.B437) Only available for students who have taken this course during their bachelor's program
		ESI.I429.L		★	Advanced Structural Organic Chemistry	2-0-0	1	B	【Chemistry】(CHM.D434)
		ESI.I431.L			Laboratory Training of Synchrotron Radiation Science	0-0-1	1,5	B,D	【Chemistry】(CHM.A431)
		ESI.I435.L		★	Current Chemistry I	1-0-0	1,2,3	B,D	【Chemistry】(CHM.A435)
		ESI.I436.L		★	Current Chemistry II	1-0-0	1,2,3	B	【Chemistry】(CHM.A436)
		ESI.I437.L		★	Current Chemistry III	1-0-0	1,2,3	B	【Chemistry】(CHM.A437)

		ESI.I438.L		★	Current Chemistry IV	1-0-0	1,2,3	B	【Chemistry】(CHM.A438)
		ESI.I441.L		★	Advanced Separation Science	2-0-0	1,5	B	【Chemistry】(CHM.B431)
		ESI.I444.L		★	Advanced Bioorganic Chemistry	2-0-0	1	B	【Chemistry】(CHM.D431)
		ESI.I461.L			Recent Progress in Chemistry I	1-0-0	1	B	【Chemistry】(CHM.A441) Only for even academic years
		ESI.I462.L			Recent Progress in Chemistry II	1-0-0	1	B	【Chemistry】(CHM.A442) Only for even academic years
		ESI.I463.L			Recent Progress in Chemistry III	1-0-0	1	B	【Chemistry】(CHM.A443) Only for even academic years
		ESI.I464.L			Recent Progress in Chemistry IV	1-0-0	1	B	【Chemistry】(CHM.A444) Only for even academic years
		ESI.I465.L			Recent Progress in Chemistry V	1-0-0	1	B	【Chemistry】(CHM.A445) Only for even academic years
		ESI.I466.L			Recent Progress in Chemistry VI	1-0-0	1	B	【Chemistry】(CHM.A446) Only for even academic years
		ESI.I467.L			Recent Progress in Chemistry VII	1-0-0	1	B	【Chemistry】(CHM.A447) Only for odd academic years
		ESI.I468.L			Recent Progress in Chemistry VIII	1-0-0	1	B	【Chemistry】(CHM.A448) Only for odd academic years
		ESI.I469.L			Recent Progress in Chemistry IX	1-0-0	1	B	【Chemistry】(CHM.A449) Only for odd academic years
		ESI.I470.L			Recent Progress in Chemistry X	1-0-0	1	B	【Chemistry】(CHM.A450)

									Only for odd academic years
		ESI.I471.L			Recent Progress in Chemistry XI	1-0-0	1	B	【Chemistry】(CHM.A451) Only for odd academic years
		ESI.I472.L			Recent Progress in Chemistry XII	1-0-0	1	B	【Chemistry】(CHM.A452) Only for odd academic years
		Mechanical Engineering Course Track 400 Level							
		ESI.K401.L		★	Mechanics of Composite Materials	1-0-0	1	A	【Mechanical Engineering】(MEC.C431)
		ESI.K402.L		★	Solid Dynamics	1-0-0	1,5	A	【Mechanical Engineering】(MEC.C433)
		ESI.K413.L		★	Properties of Solid Materials	1-0-0	1	A	【Mechanical Engineering】(MEC.E432)
		ESI.K414.L		★	Advanced Thermal-Fluids Measurement	1-0-0	1,5	A	【Mechanical Engineering】(MEC.E433)
		ESI.K421.L		★	Computational Fluid Dynamics	1-0-0	1	A	【Mechanical Engineering】(MEC.F431)
		ESI.K422.L		★	Mechanical Processing	1-0-0	1	A	【Mechanical Engineering】(MEC.G431)
		ESI.K430.L		★	Advanced course of turbulent flow and control	1-0-0	1,5	A	
		ESI.K431.L		★	Metalforming	1-0-0	1	A	【Mechanical Engineering】(MEC.G432)
		ESI.K441.L		★	Advanced Mechanical Elements	1-0-0	1,4,5	A	【Mechanical Engineering】(MEC.H431)
		ESI.K450.L		★	Advanced course of combustion physics	1-0-0	1,5	A	
		ESI.K461.L		★	Mechatronics Device and Control	1-0-0	1,3,5	A	【Mechanical Engineering】(MEC.H433)
		ESI.K462.L		★	Advanced Course of Actuator Engineering	1-0-0	1,5	A	【Mechanical Engineering】

									(MEC.H434)
		ESI.K472.L		★	Mechanism and Control for Ultra-precision Motion	1-0-0	1,5	A	【Mechanical Engineering】(MEC.J432)
		ESI.K493.L			Space Systems Initiative	2-0-0	1,3,4,5	A	【Mechanical Engineering】(MEC.M435)
		Mechanical Engineering Course Track 500 Level							
		ESI.K501.L		★	Mechanics of High Temperature Materials	1-0-0	1,5	B	【Mechanical Engineering】(MEC.C531)
		ESI.K521.L		★	Plasma Physics	1-0-0	1,5	B	【Mechanical Engineering】(MEC.E531)
		ESI.K532.L		★	Cryogenic Engineering	1-0-0	1,4,5	B	【Mechanical Engineering】(MEC.E532)
		ESI.K561.L		★	Rarefied Gas Dynamics	1-0-0	1,5	B	【Mechanical Engineering】(MEC.F532)
		ESI.K562.L		★	Precision Manufacturing Processes	1-0-0	1,5	B	【Mechanical Engineering】(MEC.G531)
		ESI.K580.L		★	Leading edge energy technology	1-0-0	1,2	B	
		ESI.K592.L			Space Systems and Missions	2-0-0	1,4	B	【Mechanical Engineering】(MEC.M532)
		Electrical and Electronic Engineering Course Track 400 Level							
		ESI.L401.L		★	Mechanical-to-electrical energy conversion	2-0-0	1,5	A	
		ESI.L402.L			Utilization of Intelligent Information Resources and Patents	1-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.G401)
		ESI.L410.L		★	Introduction to Photovoltaics	2-0-0	1,5	A	
		ESI.L411.L		★	Fundamentals of Electronic Materials	2-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.D401)
		ESI.L412.L		★	Semiconductor Physics	2-0-0	1,5	A	【Electrical and Electronic

									Engineering】(EEE.D411)
		ESI.L413.L			Electrical Modeling and Simulation	2-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.G411)
		ESI.L416.L			Advanced Electric Power Engineering	1-0-0	1,3	A	【Electrical and Electronic Engineering】(EEE.P421)
		ESI.L417.L		★	Advanced Electromagnetic Waves	2-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.S401)
		ESI.L441.L		★	VLSI Technology I	2-0-0	1	A	【Electrical and Electronic Engineering】(EEE.C441)
		ESI.L442.L		★	VLSI Technology II	2-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.C442)
		ESI.L443.L		★	Bipolar Transistors and Compound Semiconductor Devices	2-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.D451)
		ESI.L444.L			Advanced Power Semiconductor Devices	2-0-0	1,4,5	A	【Electrical and Electronic Engineering】(EEE.D481)
		ESI.L445.L		★	Plasma Engineering	2-0-0	1	A	【Electrical and Electronic Engineering】(EEE.P451)
		ESI.L446.L		★	Pulsed Power Technology	2-0-0	1,4,5	A	【Electrical and Electronic Engineering】(EEE.P461)
		ESI.L447.L		★	Wireless Communication Engineering	2-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.S451)
		ESI.L448.L			Optical Communication Systems	2-0-0	1,5	A	【Electrical and Electronic

									Engineering】(EEE.S461)
		ESI.L449.L		★	Power electronics circuits and systems	1-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.P412)
		ESI.L450L		★	Power electronics application to power systems	1-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.P413)
		ESI.L451L		★	Power electronics control and analysis	1-0-0	1,5	A	【Electrical and Electronic Engineering】(EEE.P414)
		Electrical and Electronic Engineering Course Track 500 Level							
		ESI.L501.L		★	Dielectric Property and Organic Devices	2-0-0	1	B	【Electrical and Electronic Engineering】(EEE.D501)
		ESI.L502.L		★	Magnetic Levitation and Magnetic Suspension	2-0-0	1	B	【Electrical and Electronic Engineering】(EEE.P501)
		ESI.L511.L		★	Magnetism and Spintronics	2-0-0	1,5	B	【Electrical and Electronic Engineering】(EEE.D511)
		ESI.L530.L		★	Advanced functional electron devices	2-0-0	1,2,3,4,5	B	
		ESI.L550.L		★	Nano-Structure Devices	2-0-0	1,5	B	【Electrical and Electronic Engineering】(EEE.D551)
		Materials Science and Engineering Course Track 400 Level							
		ESI.J401.L		★	Advanced Metal Physics	2-0-0	1,3,5	B	
		ESI.J402.L		★	Physical Chemistry for High Temperature Processes -Thermodynamics-	1-0-0	1,5	A	
		ESI.J403.L		★	Physical Chemistry for High Temperature Processes -Smelting and Refining Processes-	1-0-0	1,5	B	
		ESI.J404.L		★	Physical Chemistry for High Temperature Processes -Oxidation	1-0-0	1,5	B	

					of Metals-				
		ESI.J405.L		★ O	Microstructure Evolution and Diffusion in Metals	2-0-0	1,4,5	B	O: English, E: Japanese
		ESI.J407.L		★	Soft Materials Design	1-0-0	1,5	B	
		ESI.J408.L		★	Energy Conversion Ceramics Materials	1-0-0	1	A	
		ESI.J410.L		★ O	Applied Diffraction Crystallography in Metals and Alloys	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.M401) O: English, E: Japanese
		ESI.J411.L		★ E	Characterization of Nanomaterials	2-0-0	1	B	【Materials Science and Engineering】(MAT.M402) a 4Q course,E,b 1 to 2 Q (class held at Tsinghua Univ.), opening English every year
		ESI.J412.L		★ O	Environmental Degradation of Materials	2-0-0	1	B	【Materials Science and Engineering】(MAT.M403) O: English, E: Japanese
		ESI.J413.L		★	Catalysis and Electrocatalysis	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.P407) b 1 to 2 Q (class held at Tsinghua Univ.), opening English every year
		ESI.J446.L		★ E	Transport Phenomena at High Temperature - Momentum and Heat Flow -	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.M426) O: Japanese, E: English
		ESI.J447.L		★ E	Transport Phenomena at High Temperature - Flow of charged particles in solid -	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.M427) O: Japanese, E: English

		ESI.J414.L		★ E	Advanced Microstructure Design of Ferrous Materials	2-0-0	1,2,4	B	【Materials Science and Engineering】(MAT.M405) O: Japanese, E: English
		ESI.J418.L		★ O	Thermodynamics for Phase Equilibria	2-0-0	1	B	【Materials Science and Engineering】(MAT.M409) O: English, E: Japanese
		ESI.J419.L		★ O	Deformation and Strength of Solids	2-0-0	1	B	【Materials Science and Engineering】(MAT.M410) O: English, E: Japanese
		ESI.J448.L		★ E	Exercise in Materials Design	0-1-0	1,5	B	【Materials Science and Engineering】(MAT.M423) E: English, O: Japanese
		ESI.J449.L		★ E	Exercise in Physical Metallurgy	0-1-0	1,5	B	【Materials Science and Engineering】(MAT.M424) E: English, O: Japanese
		ESI.J450.L		★ O	Recovery, Recrystallization and Texture of Metals	1-0-0	1	B	【Materials Science and Engineering】(MAT.M425) O: English, E: Japanese
		ESI.J423.L		★	Soft Materials Physics	1-0-0	1,2	B	【Materials Science and Engineering】(MAT.P403)
		ESI.J424.L		★	Soft Materials Functional Physics	1-0-0	1,3	B	【Materials Science and Engineering】(MAT.P404)
		ESI.J427.L		★	Soft Materials Functional Chemistry	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.P413)
		ESI.J428.L		★	Soft Materials Function	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.P414)
		ESI.J429.L		★	Organic Materials Functional	1-0-0	1,5	B	【Materials Science

				E	Design				and Engineering】(MAT.P421) O: Japanese, E: English
		ESI.J430.L		★ E	Organic Materials Design	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.P422) O: Japanese, E: English
		ESI.J434.L			Materials Engineering and Ecology	1-0-0	3,4,5	D	【Materials Science and Engineering】(MAT.P491)
		ESI.J435.L			Advanced Course in Organic Polymer Science	1-0-0	1	B,C	【Materials Science and Engineering】(MAT.P492)
		ESI.J437.L		★	Thermal Properties of Materials	1-0-0	1,5	B	【Materials Science and Engineering】(MAT.P426)
		ESI.J438.L			Crystals Science	2-0-0	1	B	【Materials Science and Engineering】(MAT.C400)
		ESI.J439.L			Advanced Course of Dielectric and Ferroelectric Materials	2-0-0	1,5	B	【Materials Science and Engineering】(MAT.C401)
		ESI.J440.L		★	Quantum Physics in Optical Response of Materials	2-0-0	1	B	【Materials Science and Engineering】(MAT.C402)
		ESI.J441.L			Advanced Course of Ceramic Thin Film Technology	2-0-0	1,4,5	B	【Materials Science and Engineering】(MAT.C403)
		ESI.J442.L			Physics and Chemistry of Semiconductors	2-0-0	1,2,5	B	【Materials Science and Engineering】(MAT.C404)
		ESI.J443.L			Advanced Course of Instrumental Analysis for Materials	2-0-0	1,5	B	【Materials Science and Engineering】(MAT.C405)
		ESI.J445.L		★	Nuclear Materials and Structures	2-0-0	1	B	【Nuclear Engineering】(NCL.N403)
		ESI.J452.L		★	Advanced Course of Nano-Particles Science	1-0-0	1,3,4,5	A	【Materials Science and Engineering】(MAT.C416)
		ESI.J453.L			Soft Materials Chemistry	1-0-0	1,5	B	【Materials Science and Engineering】

									(MAT.P416)
		ESI.J454.L		★ E	Quantum theory of metals	2-0-0	1,5	B	【Materials Science and Engineering】 (MAT.M430) E: English , O: Japanese
		ESI.J455.L		★ E	Kinematical theory of microstructure formed by diffusionless phase transformation	2-0-0	1	B	【Materials Science and Engineering】 (MAT.M431) E: English, O: Japanese
		ESI.J456.L		★ O	Reliability and Durability of Metals and Alloys	2-0-0	1,4,5	A	【Materials Science and Engineering】 （MAT.M412） E: English, O: Japanese
		ESI.J457.L		★ O	(Practical SEM observation techniques)	0-1-0	1,4,5	A	【Materials Science and Engineering】 （MAT.M422） （Due to limted participants: Priority is given to students of Materials Science and Engineering Course）
		ESI.J458.L		★ O	Advanced microstructure design of non-ferrous materials A	1-0-0	1	A	【Materials Science and Engineering】 （MAT.M433） O: English, E: Japanese
		ESI.J459.L		★ O	Advanced microstructure design of non-ferrous materials B	1-0-0	1	A	【Materials Science and Engineering】 （MAT.M434） O: English, E: Japanese
		ESI.J460.L			Renewable Energy Conversion Materials	1-0-0	1,2,4	A,B	
		Materials Science and Engineering Course Track 500 Level							
		ESI.J501.L		★ O	Advanced Course of Materials Optics	2-0-0	1,5	B	【Materials Science and Engineering】 (MAT.C500) O: English, E: Japanese
		ESI.J503.L			Advanced Course of Material	2-0-0	1,5	B,C	【Materials Science

					Development I				and Engineering】(MAT.C502)
		ESI.J504.L		★	Advanced Course of Material Development II	2-0-0	1	B,C	【Materials Science and Engineering】(MAT.C503)
		ESI.J505.L		★	Functional Devices	2-0-0	1,2	B	【Materials Science and Engineering】(MAT.C504)
		ESI.J520.L		★	Fundamentals of electrochemistry and the application to energy conversion materials	1-0-0	1,2,3,4,5	B,C	【Materials Science and Engineering】(MAT.P506)
		ESI.J521.L		★	Analytical and analogical methods to solve the heat transfer equation and the application to infrared image processing	1-0-0	1,2,3,4,5	B,C	【Materials Science and Engineering】(MAT.P507)
		ESI.J522.L		★	Applied Vibrational Spectroscopy	1-0-0	1,4,5	B	【Materials Science and Engineering】(MAT.P512)
		ESI.J523.L		★	Plastic Electronic Materials and Devices	1-0-0	1,4,5	B	【Materials Science and Engineering】(MAT.P513)
		ESI.J524.L		★	Photoacoustic and Photothermal Techniques (PA&PT) for material testing: Principles and Applications	1-0-0	1,4,5	B	【Materials Science and Engineering】(MAT.P514)
		Chemical Science and Engineering Course Track 400 Level							
		ESI.H403.L		★	Advanced Electrochemistry I	1-0-0	1	B	
		ESI.H404.L		★	Advanced Electrochemistry II	1-0-0	1,5	B	
		ESI.H405.L		★	Advanced Inorganic Materials Chemistry I	1-0-0	1,5	B	
		ESI.H406.L		★	Advanced Inorganic Materials Chemistry II	1-0-0	1,5	B	
		ESI.H410.L		★	Topics in Properties of Semiconductors	1-0-0	1,5	B	
		ESI.H411.L		★	Topics in Applied Electrochemistry	1-0-0	1,5	B	
		ESI.H415.L		★	Advanced Organic Electrochemistry	1-0-0	1,5	B	
		ESI.H420.L		★	Advanced to Photochemistry I	1-0-0	1,5	B	
		ESI.H421.L		★	Advanced Electrochemistry I	1-0-0	1	B	【Chemical Science and Engineering】(CAP.A441)

		ESI.H422.L		★	Advanced Electrochemistry II	1-0-0	1	B	【Chemical Science and Engineering】(CAP.A442)
		ESI.H423.L			Advanced Instrumental Analysis	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A481)
		ESI.H428.L		★	Advanced Organic Synthesis I	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A423)
		ESI.H429.L		★	Advanced Organic Synthesis II	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A424)
		ESI.H430.L		★	Advanced to Photochemistry II	1-0-0	1,4,5	B	Not offered in AY 2023
		ESI.H431.L		★	Advanced Solid State Chemistry I	1-0-0	1	B	【Chemical Science and Engineering】(CAP.A461)
		ESI.H432.L		★	Advanced Solid State Chemistry II	1-0-0	1	B	【Chemical Science and Engineering】(CAP.A462)
		ESI.H433.L		★	Advanced Molecular Design of Metal Complexes I	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A463)
		ESI.H434.L		★	Advanced Molecular Design of Metal Complexes II	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A464)
		ESI.H436.L			Advanced electronic structures in solids II	1-0-0	1	B	【Chemical Science and Engineering】（CAP.A468）
		ESI.H441.L		★	Advanced Polymer Synthesis	1-0-0	1	B	【Chemical Science and Engineering】(CAP.P411)
		ESI.H443.L		★	Special Lecture on Characterization of Polymer Structures and Properties	1-0-0	1	B	【Chemical Science and Engineering】(CAP.P421)
		ESI.H444.L		★	Advanced Polymer Properties	1-0-0	1	B	【Chemical Science and Engineering】(CAP.P422)
		ESI.H445.L			Advanced Polymer Science II	1-0-0	1,3,5	B	【Chemical Science and Engineering】(CAP.P425)
		ESI.H450.L		★	Environmentally-Friendly Polymer Chemistry	1-0-0	1,5	B	
		ESI.H451.L		★	Process Systems Engineering	2-0-0	1,4,5	B	【Chemical Science

									and Engineering】(CAP.C412)
		ESI.H452.L		★	Advanced Energy Transfer Operation	2-0-0	1,4,5	B	【Chemical Science and Engineering】(CAP.C421)
		ESI.H453.L		★	Advanced Reaction Process Engineering	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.C424)
		ESI.H457.L		★	Advanced Reaction-Separation Process	1-0-0	1,4	B	【Chemical Science and Engineering】(CAP.C443)
		ESI.H494.L		★	Advanced Bioprocess Engineering	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.C425)
		ESI.H454.L		★	Computational Fluid Dynamics	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.C423)
		ESI.H455.L		★	Physico-Chemical Property Analysis in Chemical Engineering	1-0-0	1,4	B	【Chemical Science and Engineering】(CAP.C432)
		ESI.H495.L		★	Phase Equilibrium Analysis in Chemical Engineering	1-0-0	1,4	B	【Chemical Science and Engineering】(CAP.C433)
		ESI.H456.L		★	Transport Phenomena and Operation	2-0-0	1,2,4,5	B	【Chemical Science and Engineering】(CAP.C441)
		ESI.H458.L		★	Chemical Engineering for Advanced Materials and Chemicals Processing I	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.C411)
		ESI.H459.L		★	Chemical Engineering for Advanced Materials and Chemicals Processing II	1-0-0	1	B	【Chemical Science and Engineering】(CAP.C431)
		ESI.H461.L		★	Advanced Organometallic Chemistry and Catalysis I	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.T431)
		ESI.H462.L		★	Advanced Organometallic Chemistry and Catalysis II	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.T432)
		ESI.H463.L		★	Introduction to Polymer Science	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.I426)
		ESI.H465.L		★	Introduction to Polymer Chemistry	2-0-0	1,4,5	B	【Chemical Science and Engineering】(CAP.I427)

		ESI.H466.L		★	Introduction to Polymer Physical Properties	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I437)
		ESI.H467.L		★	Advanced Organometallic Chemistry and Catalysis	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I439)
		ESI.H468.L		★	Advanced course of physical chemistry of polymers	1-0-0	1	B	【Chemical Science and Engineering】（CAP.P434）
		ESI.H469.L		★	Elements of Innovative Molecular Chemistry I	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.T411）
		ESI.H470.L		★	Elements of Innovative Molecular Chemistry II	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.T412）
		ESI.H471.L		★	Advanced Coordination Chemistry	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I403)
		ESI.H472.L		★	Environmental Chemistry	2-0-0	1,5	B	【Chemical Science and Engineering】(CAP.I405)
		ESI.H473.L		★	Introduction to Chemical Engineering (Basics)	1-0-0	1,5	A	【Chemical Science and Engineering】(CAP.I407)
		ESI.H474.L		★	Advanced Supramolecular Science	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I420)
		ESI.H475.L		★	Analytical Techniques for Environmental Chemistry	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.I419)
		ESI.H476.L		★	Catalysis for the Environmental Issues	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I416)
		ESI.H477.L		★	Introduction to Chemical Engineering (Unit Operation)	1-0-0	1,5	A	【Chemical Science and Engineering】(CAP.I417)
		ESI.H478.L		★	Advanced Organic Materials Chemistry	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I423)
		ESI.H479.L		★	Advanced Geochemistry	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.I435)
		ESI.H480.L		★	Nano-Surface Chemistry and Advanced Devices	1-0-0	1,2,5	B	【Chemical Science and Engineering】

									(CAP.I446)
		ESI.H481.L		★	Functionalized Nano-Materials Chemistry I	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I438) Not offered in AY 2024
		ESI.H482.L		★	Functionalized Nano-Materials Chemistry II	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I445) Not offered in AY 2024
		ESI.H483.L		★	Elements of chemistry for functional properties I	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.T413）
		ESI.H484.L		★	Elements of chemistry for functional properties II	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.T414）
		ESI.H485.L		★	Elements of Chemical Systems Engineering I	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.T415）
		ESI.H486.L		★	Scope of Chemical Science and Engineering IB	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.I401） Only available for students who have taken this course during their bachelor's program
		ESI.H487.L			Scope of Chemical Science and Engineering IIB	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.I402） Only available for students who have taken this course during their bachelor's program
		ESI.H488.L			Introduction to the Frontiers of Environmental Chemistry I	1-0-0	1,2	B	【Chemical Science and Engineering】(CAP.I481)
		ESI.H489.L			Introduction to the Frontiers of Environmental Chemistry II	1-0-0	1,2	B	【Chemical Science and Engineering】(CAP.I482)
		ESI.H490.L			Frontiers of Chemical Science and Engineering I	1-0-0	1	B	【Chemical Science and Engineering】

									(CAP.T423)
		ESI.H491.L		★	Elements of Chemical Systems Engineering II	1-0-0	1,2	B	【Chemical Science and Engineering】（CAP.T416）
		ESI.H496.L			Frontiers of Chemical Science and Engineering II	1-0-0	1	B	【Chemical Science and Engineering】(CAP.T424)
		ESI.H497.L			Frontiers of Chemical Science and Engineering III	1-0-0	1	B	【Chemical Science and Engineering】(CAP.T425)
		ESI.H493.L		★	Advanced Polymer Assembly	1-0-0	1,4	B	【Chemical Science and Engineering】(CAP.P414)
		ESI.H498.L			Frontiers of Chemical Science and Technology IV	1-0-0	1	B	【Chemical Science and Engineering】（CAP.T426）
		ESI.H499.L			Frontiers of Chemical Science and Technology V	1-0-0	1	B	【Chemical Science and Engineering】（CAP.T427）
		Chemical Science and Engineering Course Track 500 Level							
		ESI.E521.L		★	Advanced Chemistry of Transition Metal Complexes I	1-0-0	1	B	【Chemical Science and Engineering】(CAP.A561)
		ESI.E522.L		★	Advanced Chemistry of Transition Metal Complexes II	1-0-0	1	B	【Chemical Science and Engineering】(CAP.A562)
		ESI.E530.L		★	Safety Engineering for Chemical Process	1-0-0	1	B	（【Chemical Science and Engineering】CAP.C512）
		ESI.E531.L		★	Advanced Polymer Physics	1-0-0	1	B	【Chemical Science and Engineering】（CAP.P521）
		ESI.E541.L		★	Advanced Polymer Reactions	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.P511)
		ESI.E542.L			Advanced Polymer Processing	1-0-0	1,4,5	B	【Chemical Science and Engineering】(CAP.P581)
		ESI.E543.L			Advanced Polymer Science I	1-0-0	1,2,5	B	【Chemical Science and Engineering】(CAP.P582)
		ESI.E551.L		★	Chemical Engineering in Global Business	1-0-0	1,2,3,5	B	【Chemical Science and Engineering】(CAP.C521)

		ESI.E552.L		★	Advanced Chemical Equipment Design	2-0-0	1,5	B	【Chemical Science and Engineering】(CAP.C531)
		ESI.E553.L		★	Plasma Chemistry and Plasma Processing	1-0-0	1,4	B	【Chemical Science and Engineering】(CAP.C533)
		ESI.H527.L		★	Advanced Supercritical Fluid Process	1-0-0	1,4	B	【Chemical Science and Engineering】(CAP.C534)
		ESI.E554.L		★	Fine Particle Engineering	1-0-0	1,2,4,5	B	【Chemical Science and Engineering】(CAP.C542)
		ESI.H528.L		★	Tribology and Surface Engineering	1-0-0	1,2,5	B	【Chemical Science and Engineering】(CAP.C543)
		ESI.E562.L		★	Advanced Catalytic Reactions	1-0-0	1	B	【Chemical Science and Engineering】(CAP.T532)
		ESI.E571.L		★	Advanced Strategic Organic Synthesis	1-0-0	1	B	【Chemical Science and Engineering】(CAP.I533)
		ESI.E572.L		★	Advanced Material Cycle Analysis	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.I536)
		ESI.E573.L		★	Systematic Material Design Methodology	1-0-0	4,5	B	【Chemical Science and Engineering】(CAP.I537)
		ESI.H503.L		★	Advanced Polymer Design for Energy Materials	1-0-0	1,4,5	B	
		ESI.H523.L		★	Advanced Molecular Design for Organic Synthesis I	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A521)
		ESI.H524.L		★	Advanced Molecular Design for Organic Synthesis II	1-0-0	1,5	B	【Chemical Science and Engineering】(CAP.A522)
		ESI.H525.L		★	Advanced Polymer Structures	1-0-0	1,4,5	B	【Chemical Science and Engineering】(CAP.P522)
		Computer Science Course Track 400 Level							
		ESI.M402		★	Distributed Algorithms	2-0-0	1,5		【Computer Science】（CSC.T438）
		ESI.M403			Modeling of Discrete Systems	1-1-0	1,3,5		【Artificial Intelligence】（ART.T455）

		ESI.M404			Workshop on Building Advanced Computer Network	2-0-0	1,5		【Artificial Intelligence】 (ART.T457)
		ESI.M405		★	Cyber Physical Systems	2-0-0	1,4		【Computer Science】 (CSC.T431)
		Computer Science Course Track 500 Level							
		ESI.M501		★	Fault Tolerant Distributed Algorithm	2-0-0	1		【Computer Science】 (CSC.T527)
		ESI.M502			Multimedia Information Processing	2-0-0	1		【Artificial Intelligence】 (ART.T547)
		Transdisciplinary Science and Engineering Course Track 400 Level							
		ESI.T432.L		★	Technologies for Energy and Resource Utilization	1-0-0	1,2,3	B,C	【Global Engineering for Development, Environment and Society】 (GEG.E404)
		ESI.T434.L		★	Project Design & Management F	0-1-1	2,3,4,5	C,E	【Global Engineering for Development, Environment and Society】 (GEG.P452)
		ESI.T435.L		★	The economics and systems analysis of environment, resources and technology	1-0-0	1,4,5	B,E	【Global Engineering for Development, Environment and Society】 (GEG.S402)
		ESI.T436.L		★	Energy Scenario modeling	1-0-0	1,4,5	B,C	
		ESI.T437.L		★	Environmental Policy	1-0-0	1,2,4	B,C	【Global Engineering for Development, Environment and Society】 (GEG.S401)
		ESI.T438.L		★	Geospatial data analysis for environment studies	1-0-0	1,4,5	B,C	【Global Engineering for Development, Environment and Society】 (GEG.E413)

									（The number of students may be limited.）
		Transdisciplinary Science and Engineering Course Track 500 Level							
		ESI.T501.L		★	Utilization of Resources and Wastes for Environment	1-0-0	1,2,4,5	B,C	【Global Engineering for Development, Environment and Society】 (GEG.E512) Not offered in AY 2024

Note：

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

• Competencies: , 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)

• 【 】Course offered by another graduate major

• The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ESI.D400.R): A (Interdisciplinary Scientific Principles of Energy Courses (electively required)), B (Interdisciplinary Scientific Principles of Energy Course (selective)), D(Energy Big Data Science Courses), H (Chemical Science and Engineering Courses), I (Chemistry Courses), J (Materials Science and Engineering Courses), K (Mechanical EngineeringCourses), L (Electrical and Electronic Engineering Courses), M(Computer Science Course),T(Transdisciplinary Science and Engineering Courses), Z (Research Seminars) The character “R” succeeding the course number represents that the course is electively required (A), elective (L), and required (R), respectively.

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

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the master’s degree program, students must attain at least two credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table M-1 of the “Entrepreneurship Courses” listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table M3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program.

As there are some Entrepreneurship Courses without GAs, please check carefully before registering for them.

However, it must be noted that credits attained from courses that are recognized as equivalent to Entrepreneurship Courses can be counted towards the completion requirements of the master's degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

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

GA0M: You can clearly plan your own career and recognize the abilities necessary for realizing it while considering ethics and relevance to societal problems.

GA1M: You can acquire the knowledge, skills, ethics and entrepreneurship necessary for realizing your planned career and contribute to societal problem-solving while collaborating with other experts

Table M3. Courses of the Graduate Major in Energy Science and Informatics recognized as equivalent to Entrepreneurship Courses, and Entrepreneurship Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	ESI.B502.L			Energy innovation co-creative project	0-0-1	GA1M	A,C,E	
	ESI.B503			Energy Informatics Internship A	0-0-1	GA1M	C,D,E	Course outside the standard curriculum
	ESI.B504			Energy Informatics Internship B	0-0-2	GA1M	C,D,E	Course outside the standard curriculum
	CHM.A461			Presentation Exercises in Chemistry	0-1-0	GA0M	C,E	Available only to students belonging to the Department of Chemistry
	CHM.A462			Introductory Exercises in Chemistry	0-1-0	GA1M	C,E	Available only to students belonging to the Department of Chemistry
	EEE.G401			Utilization of Intelligent Information Resources and Patents	1-0-0	GA1M	B,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	CAP.E521			Researcher Ethics and Engineer Ethics	1-0-0	GA0M	D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E422			Presentation Practice	0-1-0	GA1M	E	Available only to students belonging to

								the Department of Chemical Science and Engineering
	CAP.E411			Advanced Internship in Chemical Science and Engineering I	0-0-1	GA1M	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E412			Advanced Internship in Chemical Science and Engineering II	0-0-2	GA1M	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	SSS.S433			Ota City Start-up Experience Off-Campus Project	0.5-0-0.5	GA1M	B,C,E	【Tokyo Tech Academy of Energy and Informatics Program】(SSS.S433)
	ESI.B511.L		★	Energy Informatics Off-Campus Project S A	0-0-1	GA1M	B,C,E	
	ESI.B512.L		★	Energy Informatics Off-Campus Project S B	0-0-1	GA1M	B,C,E	
	ESI.B513.L		★	Energy Informatics Off-Campus Project S C	0-0-1	GA1M	B,C,E	
	ESI.B514.L		★	Energy Informatics Off-Campus Project S D	0-0-1	GA1M	B,C,E	
	ESI.B515.L		★	Energy Informatics Off-Campus Project L A	0-0-2	GA1M	B,C,E	
	ESI.B516.L		★	Energy Informatics Off-Campus Project L B	0-0-2	GA1M	B,C,E	
	ESI.B517.L		★	Energy Informatics Off-Campus Project L C	0-0-2	GA1M	B,C,E	
	ESI.B518.L		★	Energy Informatics Off-Campus Project L D	0-0-2	GA1M	B,C,E	
	ESI.B519.L		★	Energy Informatics International Workshop A	0-0-1	GA1M	C,E	

	ESI.B520.L		★	Energy Informatics International Workshop B	0-0-1	GA1M	C,E	
	ESI.B521.L		★	Energy Informatics International Workshop C	0-0-1	GA1M	C,E	
	ESI.B522.L		★	Energy Informatics International Workshop D	0-0-1	GA1M	C,E	
	DSA.P431			Applied Practical Data Science and Artificial Intelligence 3A	1-0-0	GA0M GA1M		
	DSA.P421			Applied Practical Science and Artificial Intelligence	1-0-0	GA0M GA1M		
	DSA.P411			Applied Practical Data Science and Artificial Intelligence 1A	1-0-0	GA0M GA1M		
	DSA.P422			Applied Practical Data Science and Artificial Intelligence 2B	1-0-0	GA0M GA1M		
Entrepreneurship Courses	ESI.C501			Master's Recurrent Program I-I of Energy Science and Informatics	0-0-1	GA0M GA1M	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics. (Cannot be counted for Major Courses)
	ESI.C502			Master's Recurrent Program I-II of Energy Science and Informatics	0-0-1	GA0M GA1M	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics. (Cannot be counted for Major Courses)
	ESI.C503			Master's Recurrent Program II of Energy Science and Informatics	0-0-2	GA0M GA1M	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics. (Cannot be counted for Major Courses)

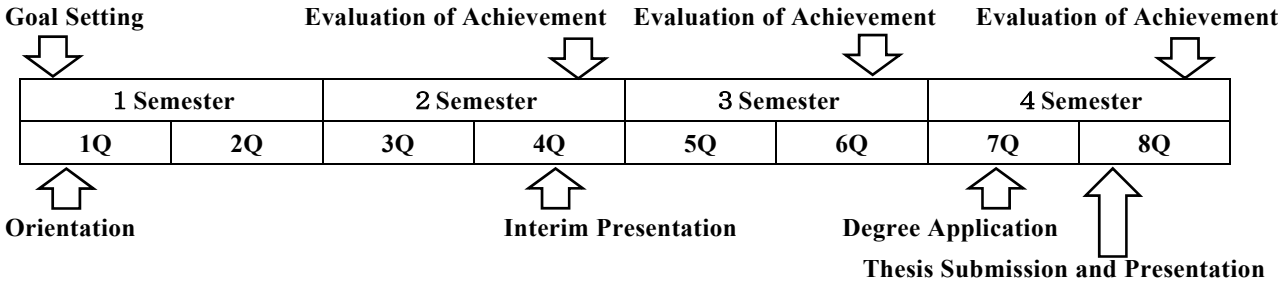
Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

＊GA: Graduate Attributes

The Tokyo Tech Academy for Leadership (ToTAL), WISE Programs, or Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the academy or center that offers the relevant program.

Research Related to the Completion of Master Thesis

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



・Interim Presentation of Master's Thesis

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

・Screening Criteria for Master's Thesis

A master's thesis must include new knowledge contributing to the development in Energy Science and Informatics 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 inter-relationships in conventional energy-related disciplines, which developed with differentiation and deepening, creation of the novel discipline, Interdisciplinary 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 Informatics Major aims at nurturing an independent research scientist and engineer with advanced expert knowledge in the field of Energy Science and Informatics. Students in this major are expected to pursue the principles of energy-related phenomena by using knowledge in the field of Energy Science and Informatics and to lead a cutting-edge research and development in consideration of societal responsibilities and ethics as well as acquire competence as a global leader who contributes to create a sustainable society.

The goals of human resource development in the Doctral Degree Program of Energy Science and Informatics course are as follows: Based on a wide and deep knowledge of one's own specialized field and Multi-dimensional Energy Theory (Interdisciplinary Principles of Energy), students acquire the ability to correctly discern the essence and universality of energy-related phenomena, independently judge and define new problems and lead them to solutions through utilizing energy big data science. Furthermore, students develop the ability to lead the frontier of energy and informatics research with high insight and ethics, and the ability to develop research by organically linking multifaceted knowledge in the energy and informatics fields. In the future, students are expected to become researchers and engineers who can build wide-ranging interpersonal networks, demonstrate international leadership, and lead the cutting-edge research and development in the energy science and informatics fields.

2. Learning Objectives (Competencies Developed)

The students are expected to acquire,

- Ability to discern the essence and universality of energy-related phenomena, and to discover and explore new issues and find solutions by utilizing energy big data science, being based on a wide range of systematic and in-depth knowledge of the energy science and informatics.
- Ability to lead the frontier of energy and information research with deep insight and ethics.
- Ability to organically combine knowledge from various fields related to the energy science and informatics to propose new projects, and to build a personal network with the social vision to explain the social and economic value of the proposed projects, and to drive and develop the projects.
- Technical communication skills based on integrated energy science and informatics related findings, from the viewpoint as an expert of energy-related discipline.
- Competence as an international leadership in the energy science and informatics field.

3. Learning Goals

Students of the Energy Science and Informatics course, in order to acquire the abilities described in "Learning Objectives", will learn the followings:

A) Advanced expert knowledge in the field of Energy Science and Informatics

Students acquire advanced specialized academic skills to discern the essence and universality of phenomena related to energy science and informatics through the study of specialized Core Courses and Research Seminnars in the Energy Science and Informatics Course.

B) Ability to solve problems

This course aims to develop practical problem-solving skills by utilizing not only one's own specialized discipline but also a wide range of understanding and knowledge in the energy science and informatics field.

C) Ability to determine the problems to be solved

This course aims to develop the ability to go beyond one's own field of expertise, freely utilize advanced specialized knowledge in each energy related field, and make creative proposals for solving new issues.

D) Competency as a global leader in energy science and Informatics research

In order to acquire the ability to demonstrate international leadership, this course focuses on the ability to develop organically link knowledge from various fields related to energy science and informatics, objectively evaluate the positioning and social importance of one's own research, and lead the frontier of energy science and informatics research by building and utilizing personal human networks.

E) Communication skills based on logical explanation

This course aims to develop technical communication skills to exchange opinions logically with expert scientists from various specialized fields in the domestic and international community and to present one's own research results and scientific values.

4. IGP Completion Requirements

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

1. Attain a total of 24 credits or more from 600-level courses.
2. From the courses specified in the Graduate Major in Energy Science and Informatics curriculum,
   - 12 credits acquired from Research Seminars;
   - 12 credits or more, acquired from the subject in 600-level courses of this major;
   - a minimum of 6 credits acquired from Liberal Arts and Basic Science Courses
     (2 credits from Humanities and Social Sciences Courses, and 4 credits from Entrepreneurship Courses
3. Pass the doctoral thesis review and defense.

Table D1 shows course categories and the number of credits required to complete the Doctoral Degree Program of this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as “associated learning goals”. Prior to registering courses, students need to fully understand the course goals.

Table D1 Graduate Major in Energy Science and Informatics 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	
	Entrepreneurship Courses		4 credits		C,D,E	All Graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA.)
	Other courses					
Core courses	Research seminars	Seminar in Energy Science and Informatics S3 Seminar in Energy Science F and Informatics 3 Seminar in Energy Science and Informatics S4 Seminar in Energy Science and Informatics F4 Seminar in Energy Science and Informatics S5 Seminar in Energy Science and Informatics F5 A total of 12 credits, 2 credits each from the above courses.		12 credits	A,B,C,D,E	
	Research-related courses				C,D,E	
	Major courses				A,B,C,D	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Energy Science and Engineering standard curriculum					
Total required credits		A minimum of 24 credits including those attained according to the above conditions				
Note		• Japanese Language and Culture Courses offered to international students can be recognized as				

	equivalent to the Humanities and Social Science Courses of the corresponding course level. **・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.**

5. IGP Courses

Table D2 shows the Core Courses of the Doctoral Degree Program of this major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

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

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	600 level	ESI.Z691.R	◎		Seminar in energy science and informatics S3	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z692.R	◎		Seminar in energy science and informatics F3	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z693.R	◎		Seminar in energy science and informatics S4	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z694.R	◎		Seminar in energy science and informatics F4	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z695.R	◎		Seminar in energy science and informatics S5	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
		ESI.Z696.R	◎		Seminar in energy science and informatics F5	0-0-2	1,3,4,5	A,B,C	Language used in Seminar depends on Laboratory.
Major courses	600 level	ESI.E601.L			Practical Presentation A	0-0-1	1,3	A,B,C,E	
		ESI.E602.L			Practical Presentation B	0-0-1	1,3	A,B,C,E	
		ESI.E603.L			Practical Presentation C	0-0-1	1,3	A,B,C,E	
		ESI.E618.L			Practical Presentation W1	0-0-1	1,3	A,B,C,E	

		ESI.E604.L		★	International scientific presentation A	0-0-1	1,3	A,B,C,D,E	
		ESI.E605.L		★	International scientific presentation B	0-0-1	1,3	A,B,C,D,E	
		ESI.E606.L		★	International scientific presentation C	0-0-1	1,3	A,B,C,D,E	
		ESI.E619.L		★	International scientific presentation W1	0-0-1	1,3	A,B,C,D,E	
		ESI.E607.L			Practical research in energy science A	0-0-1	1,3,4	A,B,C	
		ESI.E608.L			Practical research in energy science B	0-0-1	1,3,4	A,B,C	
		ESI.E613.L			Practical research in energy science C	0-0-1	1,3,4	A,B,C	
		ESI.E614.L			Practical research in energy science D	0-0-1	1,3,4	A,B,C	
		ESI.E609.L			Academic teaching	0-1-0	1,3	D,E	
		ESI.E610.L		★	Academic Writing A	1-0-0	3,4	A,C,E	
		ESI.E611.L		★	Academic Writing B	1-0-0	1,2,3,4	A,C,E	
		ESI.E612.L		★	International energy informatics project	0-0-2	2,3,4,5	C,D,E	
		ESI.E615.L			Special Experiment and Practice for Working Adults in Energy Science and Informatics Engineering 1	0-0-1	1,4,5	C	
		ESI. E616.L			Special Experiment and Practice for Working Adults in Energy Science and Informatics Engineering 2	0-0-1	1,4,5	C	
		ESI.E617.L			Special Experiment and Practice for Working Adults in Energy Science and Informatics Engineering 3	0-0-1	1,4,5	C	
		ESI.P601.L		★	Energy Science and Informatics Engineering Project	0-0-2	3,4	A,E	
		ESI.R602.L		★	Energy Science and Informatics Engineering Off-Campus Project D1c	0-0-2	3,4,5	A,C,E	
		ESI.R603.L		★	Energy Science and Informatics Engineering Off-Campus Project	0-0-4	3,4,5	A,C,E	

					D2c				
		ESI.K601.L		★	Special Lecture in Mechanical Engineering I	1-0-0	1,2	B	【Mechanical Engineering】(MEC.N631)
		ESI.K602.L		★	Special Lecture in Mechanical Engineering II	1-0-0	1,2	B	【Mechanical Engineering】(MEC.N632)
		ESI.K603.L		★	Special Lecture in Mechanical Engineering III	1-0-0	1,2	B	【Mechanical Engineering】(MEC.N633)
		ESI.K604.L		★	Special Lecture in Mechanical Engineering IV	1-0-0	1,2	B	【Mechanical Engineering】(MEC.N634)
		ESI.R604.L			Cooperative Education through Research Internships of Energy Science and Informatics	0-0-4	1,3,4,5	C,D,E	
		ESI.D601.L		★ 3E 4J	Fundamental of Progressive Data Science	1-0-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO. T677）
		ESI.D602.L			Exercises in Fundamental of Progressive Data Science	0-1-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO. T678）
		ESI.D603.L		★ 3E 4J	Fundamental of Progressive Artificial Intelligence	1-0-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO. T679）
		ESI.D604.L			Exercises in Fundamental of Progressive Artificial Intelligence)	0-1-0			【Progressive Graduate Minor in Data Science and Artificial Intelligence program】（XCO. T680）
		ESI.F601.L		★	InfoSyEnergy-outreach	0-0-1			【Tokyo Tech Academy of Energy and Informatics Program】

									(ENI.A601) (Limited to students of Tokyo Tech Academy of Energy and Informatics Program)
		ESI.F602.L		★	InfoSyEnergy Product-service design	1-0-0			Tokyo Tech Academy of Energy and Informatics Program (ENI.A602) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.F603.L		★	InfoSyEnergy-international forum	0-0-2			Tokyo Tech Academy of Energy and Informatics Program (ENI. B611) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.F604.L		★	InfoSyEnergy-international forum 2	0-0-2			Tokyo Tech Academy of Energy and Informatics Program (ENI. B612) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.F605.L		★	InfoSyEnergy-international forum 3	0-0-2			Tokyo Tech Academy of Energy and Informatics Program (ENI. B613) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.F606.L		★	InfoSyEnergy-joint research projects 1	0-0-2			Tokyo Tech Academy of Energy and

									Informatics Program (ENI. C611) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.F607.L		★	InfoSyEnergy-joint research projects 2	0-0-4			Tokyo Tech Academy of Energy and Informatics Program (ENI. C612) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.F608.L		★	InfoSyEnergy-international field work-short term	0-0-2			Tokyo Tech Academy of Energy and Informatics Program (ENI. C616) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）
		ESI.L609.L		★	InfoSyEnergy-international field work-long term	0-0-4			Tokyo Tech Academy of Energy and Informatics Program (ENI. C617) （Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program）

Note：

• ◎：Required course, ★：Classes in English

• Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)

• 【 】Course offered by another graduate major

• The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ESI.D600.R): E (Major Courses), Z (Research Seminars). The character “R” succeeding the course number represents that the course is elective (L) and required (R), respectively.

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

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least four credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table D-1 of the "Entrepreneurship Courses" listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table D3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program.

As there are some Entrepreneurship Courses without GAs, please check carefully before registering for them.

However, it must be noted that credits attained from courses that are recognized as Entrepreneurship Courses can be counted towards the completion requirements of the doctoral degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.
The Graduate Attributes of the Doctoral Degree Program are listed in Table D-1 as follows:

GA0D: You can clearly design your own career and contribute to realizing scientific, technological, or social innovation through a comprehensive understanding of the knowledge, skills, social responsibilities and ethics required to become an active member of academia and/or industry.

GA1D: You can lead in realizing scientific, technological, or social innovation by acquiring advanced leadership skills, entrepreneurship, knowledge and expertise, and by developing social responsibility necessary for materializing your designed career.

Table D3 Courses of the Graduate Major in Energy Science and Informatics recognized as equivalent to Entrepreneurship Courses in the Academic Leader Program, and Entrepreneurship Courses

Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship	ESI.E607.L			Practical research in energy science A	0-0-1	GA1D	A,B,C	
	ESI.E608.L			Practical research in energy science B	0-0-1	GA1D	A,B,C	
	ESI.E604.L		★	International scientific presentation A	0-0-1	GA1D	A,B,C,D,E	
	ESI.E605.L		★	International scientific presentation B	0-0-1	GA1D	A,B,C,D,	

Courses							E	
	ESI.E606.L		★	International scientific presentation C	0-0-1	GA1D	A,B,C,D, E	
	ESI.E619.L		★	International scientific presentation W1	0-0-1	GA1D	A,B,C,D, E	
	ESI.E609.L			Academic teaching	0-1-0	GA1D	D,E	
	ESI.E612.L		★	International energy informatics project	0-0-2	GA1D	C,D,E	
	ESI.P601.L		★	Energy Science and Informatics Engineering Project	0-0-2	GA1D	A,E	
	ESI.R602.L		★	Energy Science and Informatics Engineering Off-Campus Project D1c	0-0-2	GA1D	A,C,E	
	ESI.R603.L		★	Energy Science and Informatics Engineering Off-Campus Project D2c	0-0-4	GA1D	A,C,E	
	CHM.A661		★	Basic Exercises in Global Presentation	0-1-0	GA1D	C	Available only to students belonging to the Department of Chemistry
	CHM.A662		★	Advanced Exercises in Global Presentation	0-1-0	GA1D	C	Available only to students belonging to the Department of Chemistry
	CHM.A651			Laboratory Training of Advanced Chemistry I	0-0-1	GA1D	C	Available only to students belonging to the Department of Chemistry
	CHM.A652			Laboratory Training of Advanced Chemistry II	0-0-1	GA1D	C	Available only to students belonging to the Department of Chemistry
	CHM.A653			Laboratory Training of Advanced Chemistry III	0-0-1	GA1D	C	Available only to students belonging to the Department of Chemistry
	CHM.A654			Laboratory Training of Advanced Chemistry IV	0-0-1	GA1D	C	Available only to students belonging to the Department of Chemistry
	MEC.T631			Teaching Practice in Mechanical Engineering	0-0-2	GA1D	D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R631			Off Campus Project D1c	0-0-1	GA1D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R632			Off Campus Project D2c	0-0-2	GA1D	C,D	Available only to students belonging to the

								Department of Mechanical Engineering
	MEC.R633			Off Campus Project D3c	0-0-3	GA1D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R634			Off Campus Project D4c	0-0-4	GA1D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R635			Off Campus Project D5c	0-0-5	GA1D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.R636			Off Campus Project D6c	0-0-6	GA1D	C,D	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S631			Overseas Research Project D1c	0-0-1	GA1D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S632			Overseas Research Project D2c	0-0-2	GA1D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S633			Overseas Research Project D3c	0-0-3	GA1D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S634			Overseas Research Project D4c	0-0-4	GA1D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S635			Overseas Research Project D5c	0-0-5	GA1D	E	Available only to students belonging to the Department of Mechanical Engineering
	MEC.S636			Overseas Research Project D6c	0-0-6	GA1D	E	Available only to students belonging to the Department of Mechanical Engineering
	EEE.G601		★	Teaching Skills in English for Doctoral Course Students	0-1-0	GA1D	D,E	Available only to students belonging to the

								Department of Electrical and Electronic Engineering
	EEE.R611		★	Doctor Course Colloquium	0-1-0	GA1D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R601			Training on Teaching Technique	0-1-0	GA1D	C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R651		★	Study Abroad (Doctor Course) A	0-0-1	GA1D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R652		★	Study Abroad (Doctor Course) B	0-0-2	GA1D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R653		★	Study Abroad (Doctor Course) C	0-0-4	GA1D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R654		★	Study Abroad (Doctor Course) D	0-0-6	GA1D	B,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R661			Internship (Doctor Course) A	0-0-1	GA1D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R662			Internship (Doctor Course) B	0-0-2	GA1D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	EEE.R663			Internship (Doctor Course) C	0-0-4	GA1D	B,C,D,E	Available only to students

								belonging to the Department of Electrical and Electronic Engineering
	EEE.R664			Internship (Doctor Course) D	0-0-6	GA1D	B,C,D,E	Available only to students belonging to the Department of Electrical and Electronic Engineering
	MAT.A661			Materials Off-campus Project 1	0-0-1	GA1D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A662			Materials Off-campus Project 2	0-0-2	GA1D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A663			Materials Off-campus Project 3	0-0-4	GA1D	D	Available only to students belonging to the Department of Materials Science and Engineering
	MAT.A664			Materials Off-campus Project 4	0-0-6	GA1D	D	Available only to students belonging to the Department of Materials Science and Engineering
	CAP.E631			Chemical Science and Engineering Off-Campus Project 1	0-0-1	GA1D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E632			Chemical Science and Engineering Off-Campus Project 2	0-0-2	GA1D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E633			Chemical Science and Engineering Off-Campus Project 3	0-0-4	GA1D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	CAP.E634			Chemical Science and Engineering Off-Campus Project 4	0-0-6	GA1D	B,D	Available only to students belonging to the Department of Chemical Science and Engineering
	ESI.R604			Cooperative Education through Research Internships of Energy Science and Informatics	0-0-4	GA1D	C,D,E	

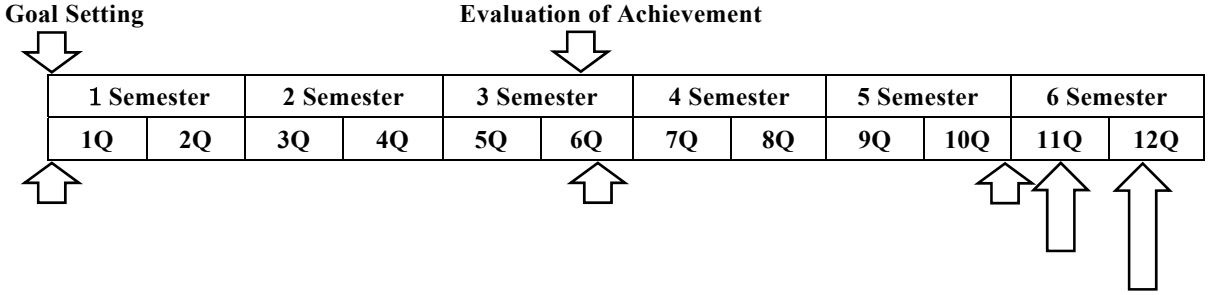
	ESI.F601.L		★	InfoSyEnergy-outreach	0-0-1	GA1D		Limited to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F603		★	InfoSyEnergy-international forum 1	0-0-2	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F604		★	InfoSyEnergy-international forum 2	0-0-2	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F605		★	InfoSyEnergy-international forum 3	0-0-2	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F606		★	InfoSyEnergy-joint research projects 1)	0-0-2	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F607		★	InfoSyEnergy-joint research projects 2	0-0-4	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F608		★	InfoSyEnergy-international field work-short term	0-0-2	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
	ESI.F609		★	InfoSyEnergy-international field work-long term	0-0-4	GA0D, GA1D		Priority is given to students of Tokyo Tech Academy of Energy and Informatics Program
Entrepreneurship Courses	ESI.C601			Doctoral Recurrent Program I of Energy Science and Informatics	0-0-1	GA0D GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics. (Cannot be counted for Major Courses)
	ESI.C602			Doctoral Recurrent Program II-I of Energy Science and Informatics	0-0-2	GA0D GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics.. (Cannot be counted for Major Courses)

	ESI.C603			Doctoral Recurrent Program II-II of Energy Science and Informatics	0-0-2	GA0D GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics.. (Cannot be counted for Major Courses)
	ESI.C604			Doctoral Recurrent Program III of Energy Science and Informatics	0-0-3	GA0D GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics.. (Cannot be counted for Major Courses)
	ESI.C605			Doctoral Recurrent Program IV of Energy Science and Informatics	0-0-4	GA0D GA1D	C,D,E	Entrepreneurship Course offered by the Graduate Major in Energy Science and Informatics.. (Cannot be counted for Major Courses)
Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide. **＊GA: Graduate Attributes**								

The Tokyo Tech Academy for Leadership (ToTAL), WISE Programs, or Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the academy or center that offers the relevant program.

Research Related to the Completion of Doctoral Thesis

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



Orientation **Interim Presentation** **Application for Doctoral Degree**
Dissertation Submission and Presentation
Final Examination

・ Criteria for Doctoral Dissertation

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

・Doctoral Dissertation Examination

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