Tohoku University

Graduate School of Engineering

STUDENT HANDBOOK

2024 Enrollment

Master's Degree Program
Opening of a course class subject list

Doctoral Degree Program
Opening of a course class subject list

Curriculum Maps

授業科目表（MC）List of Courses

Department of Mechanical Systems Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
専門基盤科目 Major Basic Subjects	数値解析学	毎年 Every year	J		2		左記の専門基盤科目の内から４科目以上選択履修し，８単位以上修得すること. A student has to earn 8 or more credits from the Major basic subjects listed in the left column.
	Numerical Analysis	隔年 Every second year	E				
	統計的モデリング Statistical modeling	毎年 Every year	JE		2		
	基盤流体力学	毎年 Every year	J		2		
	Fluid Dynamics	毎年 Every year	E				
	固体力学	毎年 Every year	J		2		
	Solid Mechanics	毎年 Every year	E				
	熱科学・工学Ａ	隔年 Every second year	J		2		
	Thermal Science and Engineering A	隔年 Every second year	E				
	熱科学・工学Ｂ	隔年 Every second year	J		2		
	Thermal Science and Engineering B	隔年 Every second year	E				
	システム制御工学Ⅰ System Control Engineering Ⅰ	毎年 Every year	E		2		
	システム制御工学Ⅱ System Control Engineering Ⅱ	毎年 Every year	E		2		
	材料化学 Materials Chemistry	毎年 Every year	E		2		
	計算機科学	隔年 Every second year	J		2		
	Computer Hardware Fundamentals	隔年 Every second year	E				
	固体物理学 Solid State Physics	毎年 Every year	E		2		
	塑性力学 Mechanics of Plasticity	毎年 Every year	E		2		
	生物の構造と機能	隔年 Every second year	J		2		
	Structure and Function Living System	隔年 Every second year	E				
	ロボットビジョン	隔年 Every second year	J		2		
	Robot Vision	隔年 Every second year	E				
	ディジタル信号処理	隔年 Every second year	J		2		
	Digital Signal Processing	隔年 Every second year	E				
	力学と物理数学	隔年 Every second year	J		2		
	Introduction to Classical Mechanics and Physical Mathematics	隔年 Every second year	E				

	連続体力学	隔年 Every second year	J		2		
	Continuum Mechanics	隔年 Every second year	E				
	応用流体力学	隔年 Every second year	J		2		
	Applied Fluid Mechanics	隔年 Every second year	E				
	構造力学	隔年 Every second year	J		2		
	Structural Mechanics	隔年 Every second year	E				
専門科目 Major General Subjects	知的機械設計学 Intelligent Machine Design				2		左記の専門科目の内から少なくとも１科目以上選択履修し２単位以上を修得するとともに，左記の科目，特別講義 A，特別研修 A，及び関連科目を選択履修し，全体で１２単位以上を修得すること． Students must earn at least 2 credits from the Major general subjects listed in the left column. In total 12 or more credits are required to earn from the Major general subjects, Special Lecture A, Advanced Seminar A, and related subjects.
	ナノ・マイクロトライボロジー	隔年 Every second year	J		2		
	Nano/Micro Tribology	隔年 Every second year	E				
	微小機械構成学 Micro-Nanomechanical Architectonics	隔年 Every second year	E		2		
	エネルギーシステム学 Energy Systems Engineering	隔年 Every second year	E		2		
	環境強度システムデザイン学	隔年 Every second year	J		2		
	Oxidation in High Temperature Environments of Structures and Materials	隔年 Every second year	E				
	機能性流体工学 Functional Fluids Engineering	隔年 Every second year	E		2		
	機械システム保全学 Mechanical Systems Maintenance Engineering	隔年 Every second year	E		2		
	固体イオニクス論 Introduction to Solid State Ionics	隔年 Every second year	E		2		
	超精密加工学	隔年 Every second year	J		2		
	Ultraprecision Machining	隔年 Every second year	E				
	精密生産システム学 Manufacturing Systems	毎年 Every year	J		2		
	自然エネルギーデザイン学	隔年 Every second year	J		2		
	Design of Natural Energy	隔年 Every second year	E				
	ニューロモルフィックデバイス工学	隔年 Every second year	J		2		
	Neuromorphic Device Engineering	隔年 Every second year	E				
	物理フラクチュオマティクス論 Physical Fluctuomatics	毎年 Every year	J		2		
	環境行政論 Environmental Administration	毎年 Every year	J		2		
	工学と生命の倫理 Ethics of Engineering and Life	毎年 Every year	JE		2		
	インターンシップ研修 Internship Training				1~2		
	国際学術インターンシップ研修 International Scientific Internship Training				1~2		

	機械機能創成特別講義Ａ Special Lecture on Mechanical Systems Engineering A				1~2		特別講義A, 特別研修Aで修得した単位は２単位まで専門科目の要件の 12 単位に含めることができる. なお, ダブルディグリープログラム, 共同教育プログラムの学生に限り, 特別講義 A の単位を８単位まで本要件に含めることができる. A total of 2 credits at most, obtained from Special Lecture A and/or Advanced Seminar A, can be included in the requirement of 12 credits. As an exception, students enrolled in the double-degree program or joint educational program can include up to 8 credits from Special Lecture A.
	機械機能創成特別研修Ａ Advanced Seminar on Mechanical Systems Engineering A				1~2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	機能システム学セミナー Seminar on Mechanical Systems	毎年 Every year	JE		2		左記のセミナーのうちから, 指導教員の所属するセミナー２単位を修得すること. Students must earn 2 credits from one of their supervisor's seminars listed in the left column.
	エネルギー学セミナー Seminar on Energy Engineering	毎年 Every year	JE		2		
	知的メカノシステム工学セミナーSeminar on Intelligent Mechano-Systems	毎年 Every year	JE		2		
	機械機能創成修士研修 Master's Thesis Research in Mechanical Systems and Engineering			8			

1, 上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Numerical Analysis 2 credits Elective Required Professor Naofumi Ohnishi Students will be taught the numerical analysis techniques which provide the basis for analysis in fluid dynamics, thermodynamics, mechanics, electromagnetics and measurement and control engineering, etc., and learn how to apply these skills. Classes will focus in particular on (1) numerical solutions for ordinary differential equations (2) the finite difference method and the finite element method for partial differential equations, and (3) linear algebra and numerical optimization methods, covering the basics of numerical analysis and their engineering applications.	**Statistical modeling** 2 credits Elective Required Professor Yuko Araki Statistical modeling is widely used in various fields of natural and social sciences to extract information from data and to solve problems. In this lectures, we will start from the basic theory underlying statistical modeling of phenomena , and then focuses on (1) how to set up flexible models, (2)how to estimate parameters of models, and (3) how to select optimal models in order to efficiently extract information from recent data with complex and diverse structures. Background knowledge on elementary probability and statistics are required.
Fluid Dynamics 2 credits Elective Required Professor Masaya Shigeta Students acquire the intuition and knowledge of the nature of fluid motion by studying the fundamentals of Fluid Dynamics with not only theories but also visualized images, observation videos, and computer graphic animations. The goal is for students to be able to predict the fluid motion and to design the control methods in aerodynamic and material processing applications. Students can also improve their abilities of scientific discussion and international communication. Keywords: Vortex, Stream/Path/Streak lines, Incompressibility/Compressibility, Conservation laws, Bernoulli's theorem, Viscosity and diffusivity, Boundary layer, Aerodynamic force, Laws of similarity, Reynolds number, Strouhal number and Kármán's vortex street, Navier-Stokes and wave equations, Analogy with heat and mass transfers, and Plasma as high-temperature chemically-reactive electromagnetic fluid.	**Solid Mechanics** 2 credits Elective Required Associate Professor Yoshiteru Aoyagi This class is designed to provide students with a comprehensive understanding of deformation of solids and covers the fundamentals of continuum solid mechanics. It focuses on two-dimensional elasticity in infinitesimal strain theory, the concept of strain and stress, and the introduction of general methods of solving the boundary value problems through the specific problems. Moreover, this class also covers the fundamentals of finite deformation theory, which is used for addressing the large deformations of solids.
Thermal Science and Engineering A 2 credits Elective Required Professor Kaoru Maruta Professor Takashi Tokumasu Associate Professor Hisashi Nakamura Associate Professor Akihiro Hayakawa In this course, students will master the fundamentals of reactive flows in thermal fluid science. In particular, the course is designed to cover flame behaviors and peculiar phenomena in laminar and turbulent combustion, the basic concept of chemical kinetics and the understanding of reaction phenomena of electrochemistry on the standpoint of thermal science. Through the class, students will further deepen their understanding of the essence of thermal phenomena and will become able to apply this to practical devices.	**Thermal Science and Engineering B** 2 credits Elective Required Professor Taku Ohara Professor Tetsushi Biwa Professor Atsuki Komiya Associate Professor Gota Kikugawa Associate Professor Eita Shoji The students will master the basic physics of thermal energy conversion and heat transfer in both micro and macroscopic scales and learn to link this knowledge to engineering applications. More specifically, the series lectures: i) the Molecular Dynamics and molecular-scale analyses of thermo-fluid phenomena, ii) oscillating-flow based heat transfer and energy conversion, iii) visualization and control of multi-scale heat and mass transfer, and iv) statistical mechanics regarding interface phenomena will be done. Students are expected to further deepen their understanding of the essence of thermal phenomena.
System Control Engineering I 2 credits Elective Required Professor Koichi Hashimoto Professor Yasuhisa Hirata New mechanical systems using advanced mechanisms are being developed in a range of areas for medical care and welfare, space exploration, disaster rescue purposes and so on. This course focuses on motion control design of increasingly advanced and complex mechanical systems. Students will learn fundamentals for non-linear system analysis and control system design methods. First, phase plane analysis methods and Lyapunov methods are introduced as the main ways to analyze non-linear systems. Next, non-linear feedback control system design methods that can be used for mechanical control systems with non-linear dynamics. Finally, students look at several control system design methods.	**System Control Engineering II** 2 credits Elective Required Professor Kazuya Yoshida Associate Professor Yusuke Tamura This course gives an advanced lecture based on the contents of "System Control Engineering I." This lecture introduces the analysis and design methods of control systems used for designing motion control for increasingly advanced and complex mechanical systems. Students will learn fundamental concepts for state and output feedback in the state space, state observer and Kalman filter, and response analysis of control systems. This class includes some exercises using MATLAB.

Materials Chemistry 2 credits

Elective Required

Professor Yutaka Watanabe

Professor Koji Amezawa

Professor Eiji Akiyama

Associate Professor Yoichi Takeda

Most metals in the earth's atmosphere inevitably change into more thermodynamically stable compounds such as oxides or sulfides. To understand this principle more precisely, students will learn chemical and electro-chemical equilibrium theory, and kinetics theory in relation to corrosion and oxidation of metals. Practical examples will be used to explain the phenomena and theories of wet corrosion and high-temperature oxidation, deepening students' understanding of the chemical and electro-chemical reactions related to macro phenomena of corrosion and oxidation. This course will be offered in English with a lecture and practice style, using English-language materials. A detailed outline of the course will be presented during the first class.

Computer Hardware Fundamentals 2 credits

Elective Required

Professor Tetsu Tanaka

Professor Hiroyuki Takizawa

Computers have become an indispensable part of modern society. In this course, both IC technology and computer architecture will be lectured for a better understanding of modern computer systems. First, CMOS-IC technology, memory technology, and 2D/3D integration technology that support a remarkable evolution of computer systems over the past few decades will be introduced. Then, the topics will move to computer architecture focusing on the structure of computer systems, issues and tradeoffs involved in the design of computer system architecture, and high-performance computing. Also, research topics on state-of-the-art IC technology and computer architecture will be presented in the lecture.

Solid State Physics 2 credits

Elective Required

Professor Hiroo Yugami

Professor Takahito Ono

Professor Ying Chen

This course targets students from mechanical engineering, system engineering and a wide range of other specialized areas. Using Introduction to Solid State Physics (Charles Kittel, Eighth Edition) as the main text, it focuses on the fundamentals of material science. Following the chapter order in this textbook, each class will cover the content associated with that chapter. The course aims to provide students from a wide range of areas with an understanding of the basics concept of solid-state physics and a broad perspective on the behavior of materials in engineering systems.

Mechanics of Plasticity 2 credits

Elective Required

Associate Professor Yoshiteru Aoyagi

Mechanics of plasticity is an extended subject of mechanics of materials, mechanics of elasticity, continuum mechanics, and solid mechanics. This lecture aims to understand the mechanical description of "plastic deformation," a fundamental phenomenon such as the strength and fracture of materials, forming process, and tribology, and to master a deformation analysis method based on plasticity. This lecture covers 1) basic concepts of plastic deformation, 2) a mechanical description of plastic deformation, 3) a simulation method using the finite element method, and 4) applications to engineering through examples.

Structure and Function of Living System 2 credits

Elective Required

Professor Yoichi Haga

Professor Makoto Ohta

Professor Takuji Ishikawa

In all types of engineering with a connection to the human body, a thorough understanding of the structure and function of the human body and other living systems is vital, as is consideration of systems geared to the special features of these living systems. This course covers the biology knowledge in terms of the basic functions and structures of living organisms that forms the basis of bioengineering. Particular emphasis will be placed on the basic knowledge and approaches necessary for deep exploration of the anatomy and physiology of the human body from the perspective of biomechanics.

Robot Vision 2 credits

Elective Required

Professor Takayuki Okatani

This course explains various problems and their solutions in computer vision. The problems are basically inverse problems in which we wish to estimate some information about an object or a scene from their image(s), such as the three-dimensional shape of a scene or the categories of object. Students will first learn a series of fundamental concepts, and then study a number of approaches to the problems of computer vision, where the main focus is on the recently developed deep learning methods.

Digital Signal Processing 2 credits

Elective Required

Professor Shingo Kagami

Associate Professor Toshinori Kuwahara

This lecture covers fundamentals of digital signal processing that provides a foundation for sensing, control, communication, voice processing, image processing, and so forth. Related subjects include discrete-time signals, discrete-time and discrete Fourier transformations, sampling, digital frequency analysis, discrete-time systems, z transformation, digital filtering, and some more advanced topics.

Introduction to Mechanics and Physical Mathematics 2 credits

Elective Required

Professor Tomonaga Okabe

In the modeling of classical mechanics, we often meet the applied mathematics, such as differential geometry or manifolds theory. These have been developed from the viewpoint of mathematical universality and do not always provide new ideas directly. But, we often need such a background to make the theoretical models. Furthermore, symbols and calculations developed in these fields are not commonly used by general engineering students or graduate students of engineering, and this is considered to be an obstacle for learning them. In this lecture, I am going to introduce those mathematical expressions as simple as possible, so that the students can employ the advanced mathematics in the general mechanical engineering field. This course can also be considered as an introduction to the tools of physical mathematics.

Continuum Mechanics 2 credits
Elective Required
Professor Takuji Ishikawa
Associate Professor Toshihiro Omori

Materials may be regarded as continuum at the macroscopic scale. In this lecture, we aim to mathematically understand the motion and deformation of materials, such as solid and fluid, at the macroscopic scale. We first explain the concepts of continuum and stress as well as vector/tensor analysis. We then derive basic equations describing the motion and deformation of continuum, such as equilibrium equation, constitutive equation and boundary conditions. This lecture is the basis of solid and fluid mechanics, which is recommended to students who want to establish a whole picture of both subjects.

Applied Fluid Mechanics 2 credits
Elective Required
Professor Jun Ishimoto
Professor Yuka Iga

This lecture will be given on the fundamentals and applications of multiphase fluid dynamics and numerical analysis related to the fluid dynamic phenomena with heterogeneous interfaces, gas-liquid two-phase flow, phase change, cavitation, and the fundamentals of turbo-type fluid machinery such as pumps and turbines. The main topics to be understand are as follows. 1) Flow pattern and classification method of gas-liquid two-phase flow, 2) Fundamentals of two-fluid model, 3) Modeling of dispersed multi-phase flow and numerical analysis, 4) Modeling of liquid atomization 5) Classification and role of fluid machinery 6) Generation of cavitation in pumps.

Structural Mechanics 2 credits
Elective Required
Professor Kanjuro Makihara
Associate Professor Keisuke Otsuka

This lecture gives a fundamental knowledge on the structural analysis and the structural design of mechanical structures. Main topics of this lecture are deformation and stress analyses of fuselage and wing structures subjected to bending, twisting and shear. (1) Fundamental of mechanical structure and material strength. (2) Vibration analysis for structures. (3) Applied load and stress analysis of mechanical structures. (4) Structural identification and structural health monitoring (5) Structural mechanics for aerospace engineering.

Nano/Micro Tribology 2 credits
Elective Required
Professor Koshi Adachi
Associate Professor Motoyuki Murashima

Many contact interfaces exist in one machine or device, and they have strong effects on the performance of the machine or device. Performance of machines and devices are sometimes limited by such contact interfaces.

Microscopic design of contact interfaces becomes important and necessary as the size of a machine or device becomes smaller or thinner together with higher performance and accuracy.

Principal properties of surfaces and contact interfaces will be explained in this lecture for such needs, and fundamentals and applications of friction and wear will be introduced.

Micro-Nanomechanical Architectonics 2 credits
Elective Required
Professor Takahito Ono
Associate Professor Masaya Toda

Designing of mechanical system based on nanotechnology is an intellectual task combining large amount of information and wide experimental knowledge. In this class, the fundamental knowledge and designing theories of the highly developed micro machines for each process of their planning, fabrication and evaluation are presented. The processes to combine mechanics, electronics, fluidics, and optical components in the design of micro mechanics, the examples of modelling, simulation and fabrication of the devices, and the evaluation and the optimization of design are lectured with several trial examples of actual designs.

Energy Systems Engineering 2 credits

Elective Required

Professor Hiroo Yugami

There are serious energy and environmental issues for the Earth and humanity. Solving the issues will demand effective usage of non-renewable energy sources and growth in the use of renewable energy generation systems. For such a purpose, new technologies for energy conversion and energy policy must be important. In this lecture, new energy conversion technologies such as fuel cells are introduced. Students also investigate energy technologies and energy policy. Based on the information, students will think current state of the energy system and the future through discussion.

Oxidation in High Temperature Environments of Structures and Materials 2 credits

Elective Required

Professor Kazuhiro Ogawa

Professor Ken Suzuki

Associate Professor Yoichi Takeda

Due to improve the operation efficiency, gas temperature of energy conversion systems, such as gas turbines and boilers, gradually increases. As a result, degradation of the structures, such as high-temperature creep, low cycle fatigue or high-temperature oxidation and corrosion, etc. may be occurred. These damages are called "aged deterioration" or "degradation".

In this lecture in the first half, the degradation in the energy conversion systems especially high-temperature oxidation is lectured, and the mechanism of high-temperature oxidation is explained. And in this lecture in the second half, presentation and discussion concerning high-temperature oxidation behavior of structures and materials are conducted.

Functional Fluids Engineering 2 credits

Elective Required

Professor Takehiko Sato

Professor Masaya Shigeta

Professor Hidemasa Takana

This course covers fluids that express functionality depending by external fields. We discuss fundamentals of fluids' structure, mechanism of exhibiting the functionalities, transport phenomena, governing equations, and diagnostic method for the functional fluids such as plasma fluid, magnetic fluid, MR or ER fluids, ionic liquid. Also, regarding advanced applications using functionalities of those fluids, we outline plasma medicine, environmental remediation, material processing, energy equipment and other topics.

Mechanical Systems Maintenance Engineering 2 credits

Elective Required

Professor Tetsuya Uchimoto

In large-scale, complicated artifacts such as various industrial plants and airplanes, maintenance activities play an important role to prevent loss of function of the systems due to aging degradation. Optimization of the maintenance activities in view of both system safety and economic performance is placed as a major key challenge. In this course, we outline the disciplines composing maintenance engineering such as reliability engineering, materials degradation, risk evaluation, nondestructive testing, failure analysis. In addition, recent works will be introduced: such as a novel health monitoring system, a vibration control system, and so on.

Introduction to Solid State Ionics 2 credits

Elective Required

Professor Koji Amezawa

Associate Professor Kazuhisa Sato

In this lecture, ionic transport phenomena in solids will be discussed. Ions in ceramics, ionic crystals, and inorganic glasses can move in varying degrees. Particularly solids showing excellent ionic conduction are called as solid-state ionic conductors, and utilized as electrolytes or electrodes of fuel cells, batteries, and electrochemical sensors. In this lecture, basics of solid-state Ionics, such as mechanisms of ionic conduction in solid, will be first explained, and then advanced applications of solid-state ionic conductors will be introduced.

Ultraprecision Machining 2 credits

Elective Required

Professor Masayoshi Mizutani

Focusing on description of the principles, technologies and applications achieving both the ultra-precise form accuracy and ultra-smooth surface roughness. The purpose of this course, especially, is to deepen understanding of Ultra-precision machining technology focusing on micro-mechanical machining, non-conventional processing, or additive manufacturing.

Manufacturing Systems 2 credits

Elective Required

Professor Masayoshi Mizutani

Adjunct Instructor Makoto Sano

Adjunct Instructor Takashi Genma

This class is included two topics. One is focusing on description of the fundamental principles and applications for intelligent CNC machining centers and industrial robots for industrial production. Machining center, Control system of CNC machine, Mechanisms and control for robot, Sensing system for robot, Software and language for robot, CAD/CAM and FMS, ultra-precision machine. The other is

Design of Natural Energy 2 credits

Elective Required

Associate Professor Anna Suzuki

Diffusion of renewable energy technologies must deal with complex and uncertain nature, which is beyond human control. This course surveys trends in renewable energy development and study design methodologies for sustainable use of energy from natural systems. The course also explores better ways to use natural energy in society and develops into designs for co-creation in the communities.

focusing on an optical instrument for LSI manufacturing systems. Design and manufacture of optical lenses, Mechanisms and control of AF/AE camera, Microscope and telescope, Laser interferometer measuring instrument, LSI production, Stepper.

Neuromorphic Device Engineering 2 credits

Elective Required
Professor Tetsu Tanaka
Associate Professor Takafumi Fukushima

High-performance and highly efficient signal processing is performed in the human brain, compared with that in conventional Neumann-type computing. In this course, from the point of view of signal processing systems beyond the present computing, we will review brain and nervous systems. The students will be able to:
・Understand the detail structures and functions of neurons as a basic neural element.
・Learn about neuromorphic devices and system integration concept/technology.
1st. Introduction & elements of nervous systems
2nd. Neuronal potential and nervous excitement
3rd. Mechanism of synapse transmission
4th. Sensory systems
5th. Neural network
6th. Special talk
7th. Neuromorphic devices 1
8th. Neuromorphic devices 2
9th. Neuromorphic system integration 1
10th. Neuromorphic system integration 2
11th. Neuromorphic system integration 3
12th. Special talk

Physical Fluctuomatics 2 credits

Elective Required
Professor Kazuyuki Tanaka

Applications to many fields in engineering like control, signal processing etc. and in information sciences are in mind through the lecture course for the basic knowledge of statistical machine learning theory as well as stochastic processes. Brief introduction will be given to methods for applications like statistical estimation etc., and to the relationship with statistical-mechanical informatics. We first lecture probability and statistics and their fundamental properties and explain the basic frameworks of Bayesian estimation and maximum likelihood estimation. Particularly, we show EM algorithm as one of familiar computational schemes to realize the maximum likelihood estimation. As one of linear statistical models, we introduce Gaussian graphical model and show the explicit procedure for Bayesian estimation and EM algorithm from observed data. We show some useful probabilistic models which are applicable to probabilistic information processing in the standpoint of Bayesian estimation. We mention that some of these models can be regarded as physical models in statistical mechanics. Fundamental structure of belief propagation methods is reviewed as powerful key algorithms to compute some important statistical quantities, for example, averages, variances and covariances. Particularly, we clarify the relationship between belief propagations and some approximate methods in statistical mechanics. As ones of application to probabilistic information processing based on Bayesian estimation and maximum likelihood estimations, we show probabilistic image processing and probabilistic reasoning. Moreover, we also review quantum-mechanical extensions of probabilistic information processing.

Environmental Administration 2 credits

Elective Required
Various teachers

The Graduate School of Environmental Studies has had a cooperation agreement with Miyagi Prefecture and Sendai City, respectively.
In this lecture, students learn about current status and issues related to environmental policies of Miyagi Prefecture and Sendai City (about climate change such as global warming, promotion of waste reduction and recycling including plastic recycling, and environment-related laws) to achieve environmental conservation and sustainable society and learn about environmental policies and environmental technologies.
In addition to lectures, this course can help students acquire practical knowledge and develop their ability to think about how to respond to environmental issues through exercise and facility tour.

Ethics of Engineering and Life 2 credits

Elective Required
Professor Tetsutaro Hattori

We will study wide range of ethical issues including "research ethics", which are important for researchers and engineers. Not only medical science but also engineering is closely related to “life”. Applying some engineering technologies to various fields such as medicine and food productions, we undoubtedly face the matter of life and death in humans and other creatures. The intrinsic influence of engineering is huge, which requires us to acquire sophisticated knowledge and learn the ethical norm. We will invite experts engaged in various fields to give lectures. We will also arrange group discussion and presentation.
*Note for foreign students: Lectures are given in Japanese. In slides and handouts, some lecturers give titles etc. both in Japanese and English, but others do not.

Internship Training 1 or 2 credits

Elective Required
All teachers

Practical training and research conducted at a company for around one week to one month in the first year of master's program. Through this training, students learn how to apply the basic research at university to a real industrial technology setting. Additionally, students gain on-site experience and understand the realities of planning, surveys and research, product development, manufacturing and product management, etc., in companies. It is desirable that all students take this training. One or two credits are given to them according to the content and the period of the training.

International Scientific Internship Training 1 or 2 credits

Elective Required
All teachers

When students have attended any lectures or practiced in a foreign academic organization or science program, one or two credits are given to them according to the content and the period.

Special Lecture on Mechanical Systems Engineering A

1 or 2 credits
Elective Required
Various teachers

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Advanced Seminar on Mechanical Systems Engineering A

1 or 2 credits
Elective Required
Various teachers

Addressing leading-edge academic research in the major area, this course comprises seminars on a subject which student have chosen themselves as well as training in and beyond the university. Integrating these advanced specialist knowledge helps to develop students' problem-posing ability.

Seminar on Mechanical Systems 2 credits

Elective Required
Professor Koshi Adachi
Professor Takahito Ono
Professor Kazuhiro Ogawa
Professor Tetsu Tanaka
Professor Masayoshi Mizutani
Associate Professor Masaya Toda
Associate Professor Kazuhisa Sato
Associate Professor Takafumi Fukushima
Associate Professor Yuji Ichikawa
Associate Professor Motoyuki Murashima

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Energy Engineering 2 credits

Elective Required
Professor Hiroo Yugami
Professor Tetsushi Biwa
Professor Masaya Shigeta
Professor Kaoru Maruta
Professor Tetsuya Uchimoto
Professor Yuka Iga
Professor Koji Amezawa
Professor Atsuki Komiya
Professor Hidemasa Takana
Associate Professor Hisashi Nakamura
Associate Professor Junnosuke Okajima
Associate Professor Makoto Shimizu
Associate Professor Anna Suzuki

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Intelligent Mechano-Systems 2 credits

Elective Required
Professor Takehiko Sato

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Master's Thesis Research in Mechanical Systems and Engineering 8 credits

Required
Various teachers

Students engage in experiments and seminars, including research presentations, discussion, and literature reviews. Students who have acquired credits from the Innovation Oriented Seminar on Mechanical Engineering program do not need to take this course.

授業科目表（MC）List of Courses

Department of Finemechanics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
専門基盤科目 Major Basic Subjects	数値解析学	毎年 Every year	J		2		左記の専門基盤科目の内から４科目以上選択履修し，８単位以上修得すること． A student has to earn 8 or more credits from the Major basic subjects listed in the left column.
	Numerical Analysis	隔年 Every second year	E				
	統計的モデリング Statistical modeling	毎年 Every year	JE		2		
	基盤流体力学	毎年 Every year	J		2		
	Fluid Dynamics	毎年 Every year	E				
	固体力学	毎年 Every year	J		2		
	Solid Mechanics	毎年 Every year	E				
	熱科学・工学A	隔年 Every second year	J		2		
	Thermal Science and Engineering A	隔年 Every second year	E				
	熱科学・工学B	隔年 Every second year	J		2		
	Thermal Science and Engineering B	隔年 Every second year	E				
	システム制御工学Ｉ System Control Engineering Ⅰ	毎年 Every year	E		2		
	システム制御工学Ⅱ System Control Engineering Ⅱ	毎年 Every year	E		2		
	材料化学 Materials Chemistry	毎年 Every year	E		2		
	計算機科学	隔年 Every second year	J		2		
	Computer Hardware Fundamentals	隔年 Every second year	E				
	固体物理学 Solid State Physics	毎年 Every year	E		2		
	塑性力学 Mechanics of Plasticity	毎年 Every year	E		2		
	生物の構造と機能	隔年 Every second year	J		2		
	Structure and Function Living System	隔年 Every second year	E				
	ロボットビジョン	隔年 Every second year	J		2		
	Robot Vision	隔年 Every second year	E				
	ディジタル信号処理	隔年 Every second year	J		2		
	Digital Signal Processing	隔年 Every second year	E				
	力学と物理数学	隔年 Every second year	J		2		
	Introduction to Classical Mechanics and Physical Mathematics	隔年 Every second year	E				

	連続体力学	隔年 Every second year	J		2		
	Continuum Mechanics	隔年 Every second year	E				
	応用流体力学	隔年 Every second year	J		2		
	Applied Fluid Mechanics	隔年 Every second year	E				
	構造力学	隔年 Every second year	J		2		
	Structural Mechanics	隔年 Every second year	E				
専門科目 Major General Subjects	光計測 Optical Metrology	隔年 Every second year	E		2		左記の専門科目の内から少なくとも１科目以上選択履修し２単位以上を修得するとともに，左記の科目，特別講義 A，特別研修 A，及び関連科目を選択履修し，全体で１２単位以上を修得すること． Students must earn at least 2 credits from the Major general subjects listed in the left column. In total 12 or more credits are required to earn from the Major general subjects, Special Lecture A, Advanced Seminar A, and related subjects.
	材料システム計測評価学	隔年 Every second year	J		2		
	Sensing and Evaluation of Materials System	隔年 Every second year	E				
	超精密加工学	隔年 Every second year	J		2		
	Ultraprecision Machining	隔年 Every second year	E				
	ナノ・マイクロメカノプティクス Nano/Micro Mechanoptics	隔年 Every second year	E		2		
	ナノ・マイクロトライボロジー	隔年 Every second year	J		2		
	Nano/Micro Tribology	隔年 Every second year	E				
	グリーンナノテクノロジー Green Nanotechnology	隔年 Every second year	E		2		
	地殻構造・エネルギー工学 Geo-technical and Energy Engineering	隔年 Every second year	JE		2		
	精密生産システム学 Manufacturing Systems	毎年 Every year	J		2		
	材料システム設計学	隔年 Every second year	J		2		
	Design of Materials System	隔年 Every second year	E				
	バイオセンサ工学 Biosensor Engineering	隔年 Every second year	E		2		
	バイオマイクロマシン工学 Bio-Micromachine Engineering	隔年 Every second year	E		2		
	生物流体工学	隔年 Every second year	J		2		
	Biofluid Mechanics	隔年 Every second year	E				
	バイオメカニクス特別講義Ⅰ	隔年 Every second year	J		2		
	Special Lecture Series on Integrated Biomechanics Ⅰ	隔年 Every second year	E				
	知的メカノシステム解析学 Intelligent Mechanosystem Analysis	隔年 Every second year	E		2		
	表面ナノ・マイクロ計測制御学 Nano-and Micro-Surface Metrology and Engineering	隔年 Every second year	E		2		
	物理フラクチュオマティクス論 Physical	毎年 Every year	J		2		

	Fluctuomatics						
	環境行政論 Environmental Administration	毎年 Every year	J		2		
	工学と生命の倫理 Ethics of Engineering and Life	毎年 Every year	JE		2		
	インターンシップ研修 Internship Training				1~2		
	国際学術インターンシップ研修 International Scientific InternshipTraining				1~2		
	ファインメカニクス特別講義A Special Lecture on Finemechanics A				1~2		特別講義 A, 特別研修 A で修得した単位は 2 単位まで専門科目の要件の 12 単位に含めることができる. なお, ダブルディグリープログラム, 共同教育プログラムの学生に限り, 特別講義 A の単位を 8 単位まで本要件に含めることができる. A total of 2 credits at most, obtained from Special Lecture A and/or Advanced Seminar A, can be included in the requirement of 12 credits. As an exception, students enrolled in the double-degree program or joint educational program can include up to 8 credits from Special Lecture A.
	ファインメカニクス特別研修A Advanced Seminar on Finemechanics A				1~2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	材料メカニクスセミナー Seminar on Materials and Mechanics	毎年 Every year	JE		2		左記のセミナーのうちから, 指導教員の所属するセミナー 2 単位を修得すること. Students must earn 2 credits from one of their supervisor's seminars listed in the left column.
	ナノメカニクスセミナー Seminar on Nanomechanics	毎年 Every year	JE		2		
	バイオメカニクスセミナー Seminar on Biomechanics	毎年 Every year	JE		2		
	知的メカノシステム工学セミナー Seminar on Intelligent Mechano-Systems	毎年 Every year	JE		2		
	ファインメカニクス修士研修 Master's Thesis Research in Finemechanics			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Numerical Analysis 2 credits Elective Required Professor Naofumi Ohnishi Students will be taught the numerical analysis techniques which provide the basis for analysis in fluid dynamics, thermodynamics, mechanics, electromagnetics and measurement and control engineering, etc., and learn how to apply these skills. Classes will focus in particular on (1) numerical solutions for ordinary differential equations (2) the finite difference method and the finite element method for partial differential equations, and (3) linear algebra and numerical optimization methods, covering the basics of numerical analysis and their engineering applications.	**Statistical modeling** 2 credits Elective Required Professor Yuko Araki Statistical modeling is widely used in various fields of natural and social sciences to extract information from data and to solve problems. In this lectures, we will start from the basic theory underlying statistical modeling of phenomena , and then focuses on (1) how to set up flexible models, (2)how to estimate parameters of models, and (3) how to select optimal models in order to efficiently extract information from recent data with complex and diverse structures. Background knowledge on elementary probability and statistics are required.
Fluid Dynamics 2 credits Elective Required Professor Masaya Shigeta Students acquire the intuition and knowledge of the nature of fluid motion by studying the fundamentals of Fluid Dynamics with not only theories but also visualized images, observation videos, and computer graphic animations. The goal is for students to be able to predict the fluid motion and to design the control methods in aerodynamic and material processing applications. Students can also improve their abilities of scientific discussion and international communication. Keywords: Vortex, Stream/Path/Streak lines, Incompressibility/Compressibility, Conservation laws, Bernoulli’s theorem, Viscosity and diffusivity, Boundary layer, Aerodynamic force, Laws of similarity, Reynolds number, Strouhal number and Kármán’s vortex street, Navier-Stokes and wave equations, Analogy with heat and mass transfers, and Plasma as high-temperature chemically-reactive electromagnetic fluid.	**Solid Mechanics** 2 credits Elective Required Associate Professor Yoshiteru Aoyagi This class is designed to provide students with a comprehensive understanding of deformation of solids and covers the fundamentals of continuum solid mechanics. It focuses on two-dimensional elasticity in infinitesimal strain theory, the concept of strain and stress, and the introduction of general methods of solving the boundary value problems through the specific problems. Moreover, this class also covers the fundamentals of finite deformation theory, which is used for addressing the large deformations of solids.
Thermal Science and Engineering A 2 credits Elective Required Professor Kaoru Maruta Professor Takashi Tokumasu Associate Professor Hisashi Nakamura Associate Professor Akihiro Hayakawa In this course, students will master the fundamentals of reactive flows in thermal fluid science. In particular, the course is designed to cover flame behaviors and peculiar phenomena in laminar and turbulent combustion, the basic concept of chemical kinetics and the understanding of reaction phenomena of electrochemistry on the standpoint of thermal science. Through the class, students will further deepen their understanding of the essence of thermal phenomena and will become able to apply this to practical devices.	**Thermal Science and Engineering B** 2 credits Elective Required Professor Taku Ohara Professor Tetsushi Biwa Professor Atsuki Komiya Associate Professor Gota Kikugawa Associate Professor Eita Shoji The students will master the basic physics of thermal energy conversion and heat transfer in both micro and macroscopic scales and learn to link this knowledge to engineering applications. More specifically, the series lectures: i) the Molecular Dynamics and molecular-scale analyses of thermo-fluid phenomena, ii) oscillating-flow based heat transfer and energy conversion, iii) visualization and control of multi-scale heat and mass transfer, and iv) statistical mechanics regarding interface phenomena will be done. Students are expected to further deepen their understanding of the essence of thermal phenomena.

System Control Engineering I 2 credits

Elective Required

Professor Koichi Hashimoto

Professor Yasuhisa Hirata

New mechanical systems using advanced mechanisms are being developed in a range of areas for medical care and welfare, space exploration, disaster rescue purposes and so on. This course focuses on motion control design of increasingly advanced and complex mechanical systems. Students will learn fundamentals for non-linear system analysis and control system design methods. First, phase plane analysis methods and Lyapunov methods are introduced as the main ways to analyze non-linear systems. Next, non-linear feedback control system design methods that can be used for mechanical control systems with non-linear dynamics. Finally, students look at several control system design methods.

System Control Engineering II 2 credits

Elective Required

Professor Kazuya Yoshida

Associate Professor Yusuke Tamura

This course gives an advanced lecture based on the contents of "System Control Engineering I." This lecture introduces the analysis and design methods of control systems used for designing motion control for increasingly advanced and complex mechanical systems. Students will learn fundamental concepts for state and output feedback in the state space, state observer and Kalman filter, and response analysis of control systems. This class includes some exercises using MATLAB.

Materials Chemistry 2 credits

Elective Required

Professor Yutaka Watanabe

Professor Koji Amezawa

Professor Eiji Akiyama

Associate Professor Yoichi Takeda

Most metals in the earth's atmosphere inevitably change into more thermodynamically stable compounds such as oxides or sulfides. To understand this principle more precisely, students will learn chemical and electro-chemical equilibrium theory, and kinetics theory in relation to corrosion and oxidation of metals. Practical examples will be used to explain the phenomena and theories of wet corrosion and high-temperature oxidation, deepening students' understanding of the chemical and electro-chemical reactions related to macro phenomena of corrosion and oxidation. This course will be offered in English with a lecture and practice style, using English-language materials. A detailed outline of the course will be presented during the first class.

Computer Hardware Fundamentals 2 credits

Elective Required

Professor Tetsu Tanaka

Professor Hiroyuki Takizawa

Computers have become an indispensable part of modern society. In this course, both IC technology and computer architecture will be lectured for a better understanding of modern computer systems. First, CMOS-IC technology, memory technology, and 2D/3D integration technology that support a remarkable evolution of computer systems over the past few decades will be introduced. Then, the topics will move to computer architecture focusing on the structure of computer systems, issues and tradeoffs involved in the design of computer system architecture, and high-performance computing. Also, research topics on state-of-the-art IC technology and computer architecture will be presented in the lecture.

Solid State Physics 2 credits

Elective Required

Professor Hiroo Yugami

Professor Takahito Ono

Professor Ying Chen

This course targets students from mechanical engineering, system engineering and a wide range of other specialized areas. Using Introduction to Solid State Physics (Charles Kittel, Eighth Edition) as the main text, it focuses on the fundamentals of material science. Following the chapter order in this textbook, each class will cover the content associated with that chapter. The course aims to provide students from a wide range of areas with an understanding of the basics concept of solid-state physics and a broad perspective on the behavior of materials in engineering systems.

Mechanics of Plasticity 2 credits

Elective Required

Associate Professor Yoshiteru Aoyagi

Mechanics of plasticity is an extended subject of mechanics of materials, mechanics of elasticity, continuum mechanics, and solid mechanics. This lecture aims to understand the mechanical description of "plastic deformation," a fundamental phenomenon such as the strength and fracture of materials, forming process, and tribology, and to master a deformation analysis method based on plasticity. This lecture covers 1) basic concepts of plastic deformation, 2) a mechanical description of plastic deformation, 3) a simulation method using the finite element method, and 4) applications to engineering through examples.

Structure and Function of Living System 2 credits

Elective Required

Professor Yoichi Haga

Professor Makoto Ohta

Professor Takuji Ishikawa

In all types of engineering with a connection to the human body, a thorough understanding of the structure and function of the human body and other living systems is vital, as is consideration of systems geared to the special features of these living systems. This course covers the biology knowledge in terms of the basic functions and structures of living organisms that forms the basis of bioengineering. Particular emphasis will be placed on the basic knowledge and approaches necessary for deep exploration of the anatomy and physiology of the human body from the perspective of biomechanics.

Robot Vision 2 credits

Elective Required

Professor Takayuki Okatani

This course explains various problems and their solutions in computer vision. The problems are basically inverse problems in which we wish to estimate some information about an object or a scene from their image(s), such as the three-dimensional shape of a scene or the categories of object. Students will first learn a series of fundamental concepts, and then study a number of approaches to the problems of computer vision, where the main focus is on the recently developed deep learning methods.

Digital Signal Processing 2 credits
Elective Required
Professor Shingo Kagami
Associate Professor Toshinori Kuwahara

This lecture covers fundamentals of digital signal processing that provides a foundation for sensing, control, communication, voice processing, image processing, and so forth. Related subjects include discrete-time signals, discrete-time and discrete Fourier transformations, sampling, digital frequency analysis, discrete-time systems, z transformation, digital filtering, and some more advanced topics.

Introduction to Mechanics and Physical Mathematics 2 credits
Elective Required
Professor Tomonaga Okabe

In the modeling of classical mechanics, we often meet the applied mathematics, such as differential geometry or manifolds theory. These have been developed from the viewpoint of mathematical universality and do not always provide new ideas directly. But, we often need such a background to make the theoretical models. Furthermore, symbols and calculations developed in these fields are not commonly used by general engineering students or graduate students of engineering, and this is considered to be an obstacle for learning them. In this lecture, I am going to introduce those mathematical expressions as simple as possible, so that the students can employ the advanced mathematics in the general mechanical engineering field. This course can also be considered as an introduction to the tools of physical mathematics.

Continuum Mechanics 2 credits
Elective Required
Professor Takuji Ishikawa
Associate Professor Toshihiro Omori

Materials may be regarded as continuum at the macroscopic scale. In this lecture, we aim to mathematically understand the motion and deformation of materials, such as solid and fluid, at the macroscopic scale. We first explain the concepts of continuum and stress as well as vector/tensor analysis. We then derive basic equations describing the motion and deformation of continuum, such as equilibrium equation, constitutive equation and boundary conditions. This lecture is the basis of solid and fluid mechanics, which is recommended to students who want to establish a whole picture of both subjects.

Applied Fluid Mechanics 2 credits
Elective Required
Professor Jun Ishimoto
Professor Yuka Iga

This lecture will be given on the fundamentals and applications of multiphase fluid dynamics and numerical analysis related to the fluid dynamic phenomena with heterogeneous interfaces, gas-liquid two-phase flow, phase change, cavitation, and the fundamentals of turbo-type fluid machinery such as pumps and turbines. The main topics to be understand are as follows. 1) Flow pattern and classification method of gas-liquid two-phase flow, 2) Fundamentals of two-fluid model, 3) Modeling of dispersed multi-phase flow and numerical analysis, 4) Modeling of liquid atomization 5) Classification and role of fluid machinery 6) Generation of cavitation in pumps.

Structural Mechanics 2 credits
Elective Required
Professor Kanjuro Makihara
Associate Professor Keisuke Otsuka

This lecture gives a fundamental knowledge on the structural analysis and the structural design of mechanical structures. Main topics of this lecture are deformation and stress analyses of fuselage and wing structures subjected to bending, twisting and shear. (1) Fundamental of mechanical structure and material strength. (2) Vibration analysis for structures. (3) Applied load and stress analysis of mechanical structures. (4) Structural identification and structural health monitoring (5) Structural mechanics for aerospace engineering.

Optical Metrology 2 credits
Elective Required
Professor Wei Gao
Associate Professor Hiraku Matsukuma

This course focuses on precision metrology based on optical measuring methods and systems for ultraprecision manufacturing, including measurement of displacement and vibrations, surface profiles, geometric forms and motions of precision machines. Fundamental theories of geometrical optics and wave optics and applications of optical sensor technologies, such as linear encoder, autocollimator, laser triangulation sensor, laser interferometer, etc., as well as those of 3D measuring instruments, such as surface interferometer, interference microscope, optical scanner, machine vision, etc., will be learned through presentations and discussions. Precision optical metrology based on ultrashort pulse laser and optical frequency comb will also be treated.

Sensing and Evaluation of Materials System 2 credits
Elective Required
Professor Hitoshi Soyama
Professor Hironori Tohmyoh

Advanced materials system composed of the variety of materials produces various functions. To operate such a materials system without failure for realizing a safe society, comprehensive understanding of the system, which requires trials not tied to conventional methodologies, is indispensable. In this course, in addition to the error theory, which is the basis of measurement, and the inverse problem analysis for identifying the physical quantities, the evaluation of residual strain, which exists in various devices and structures, is treated. Moreover, the methods for evaluating cracks or material degradation in advanced materials system having various scales from electronic devices to various plants are lectured.

Ultraprecision Machining 2 credits
Elective Required
Professor Masayoshi Mizutani

Focusing on description of the principles, technologies and applications achieving both the ultra-precise form accuracy and ultra-smooth surface roughness. The purpose of this course, especially, is to deepen understanding of Ultra-precision machining technology focusing on micro-mechanical machining, non-conventional processing, or additive manufacturing.

Nano/Micro Mechanoptics 2 credits
Elective Required
Professor Yoshiaki Kanamori
Associate Professor Naoki Inomata

Mechanoptics is the fusional research field of optics and mechanics. Nano/Micro mechanoptics is a research field of mechanoptics on nano/micrometer scales. Fundamental technologies and applications in the field are surveyed. The topics on micrometer scale are spatial modulators for displays, micromechanical systems for optical telecommunication, optical sensors, etc. The topics on nanometer scale are wavelength-selective optical filters using subwavelength mechanical structures, optical devices for controlling surface optical reflectance and light polarization, and structural optics smaller than the subwavelength optics. Micro/Nanometer scale fabrication technologies for micro/nano mechanoptics are also studied. The latest papers relating to the above are also presented and discussed.

Nano/Micro Tribology 2 credits
Elective Required
Professor Koshi Adachi
Associate Professor Motoyuki Murashima

Many contact interfaces exist in one machine or device, and they have strong effects on the performance of the machine or device. Performance of machines and devices are sometimes limited by such contact interfaces.
Microscopic design of contact interfaces becomes important and necessary as the size of a machine or device becomes smaller or thinner together with higher performance and accuracy.
Principal properties of surfaces and contact interfaces will be explained in this lecture for such needs, and fundamentals and applications of friction and wear will be introduced.

Green Nanotechnology 2 credits
Elective Required
Professor Kazuhiko Endo

Nanofabrication (etching, deposition, and surface modification) of advanced devices such as ULSIs, nanomachines, optical devices, and bio chips are realized by means of reactive plasmas, scanning tunneling microscope (STM) and so on, via interaction between the device material and microscopic particles such as atoms, molecules, ions, radicals, and photons. This lecture will introduce behavior and interaction of such microscopic particles in processes such as reactive plasma, beam, and atom/molecule handling which are basis of advanced technologies. Measurement methods of such interactions will be explained. Examples of advanced green nanodevices and nano processes used in these devices advanced industries will be introduced.

Geo-technical and Energy Engineering 2 credits

Elective Required
Professor Takatoshi Ito
Professor Hirokazu Moriya
Associate Professor Kiyotoshi Sakaguchi

This course provides an introduction to geomechanics and engineering techniques for exploitation of geo-energy, especially geothermal energy. The class will explore the status and origin of temperature and stress fields in subsurface rocks, hydraulic fracturing techniques used for creating fractures and improving hydraulic properties of rocks, micro seismic imaging and event analysis used for determining geometry and characteristics of fractures, and well testing carried out for determining well and reservoir performance.

Manufacturing Systems 2 credits

Elective Required
Professor Masayoshi Mizutani
Adjunct Instructor Makoto Sano
Adjunct Instructor Takashi Genma

This class is included two topics. One is focusing on description of the fundamental principles and applications for intelligent CNC machining centers and industrial robots for industrial production. Machining center, Control system of CNC machine, Mechanisms and control for robot, Sensing system for robot, Software and language for robot, CAD/CAM and FMS, ultra-precision machine. The other is focusing on an optical instrument for LSI manufacturing systems. Design and manufacture of optical lenses, Mechanisms and control of AF/AE camera, Microscope and telescope, Laser interferometer measuring instrument, LSI production, Stepper.

Design of Materials System 2 credits

Elective Required
Professor Takeshi Yamaguchi

This course will provide all students with the fundamental knowledge of material design to develop intelligent mechanical systems with high performance. This course will also review the latest knowledge and concept associated with material system design.

Biosensor Engineering 2 credits

Elective Required
Professor Matsuhiko Nishizawa

Biological molecular systems for transduction of information and energy will be briefly lectured, followed by the lecture of the construction, mechanism, and technical trends on biosensors utilizing bio elements such as enzymes and antibodies. Bio interface engineering for integrating bio elements with the electric devices will also be lectured for educating ability for engineering innovative biosensors for advanced medicines.

Bio-Micromachine Engineering 2 credits

Elective Required
Professor Matsuhiko Nishizawa

The progress of Bio micro machine, which is the fusion of biotechnology and micromachine technology, will be fully lectured, assuming their use for advanced medicines. The processing of biocompatible soft materials is important content of this lecture because the fusion of bio elements and the electric devices requires suitable bio interface techniques utilizing smart biomaterials.

Biofluid Mechanics 2 credits

Elective Required
Professor Takuji Ishikawa

In this lecture, we learn functions of biological flows in terms of fluid mechanics. Flow field at the cellular scale can be regarded as Stokes flow. We learn basic characteristics and mathematical descriptions of Stokes flow. Flow generated by flagella, swimming microorganisms, motions of vesicles and cells are discussed. Rheology of biofluids is explained by introducing various constitutive laws. Flow in a human body, flying birds, swimming fish and fluid mechanics in spots are lectured. We show fluid mechanics can be a strong tool to understand biological functions.

Special Lecture Series on Integrated Biomechanics I 2 credits

Elective Required
Professor Makoto Ohta
Associate Professor Kenji Kikuchi

The mechanical function and structure of living organisms will be described in detail from the standpoint of continuum mechanics. In particular, we will establish understanding for future research, such as fluid dynamics of blood flow and airflow, muscles, blood vessels, and cells as soft materials, and static and dynamics of skeletal systems as hard materials. Then, we will explain the measurement and visualization methods of the information from the living body and learn the principles of measurements for biological information and its application.

(Note) This course is offered in Japanese and English every other year.

Intelligent Mechanosystem Analysis 2 credits

Elective Required
Associate Professor Kenichi Funamoto

Intelligent mechano-systems are generally modeled as infinite-dimensional nonlinear dynamical systems. As a basis of modern control theory to deal with such systems, we first study basic concepts of function spaces, dual spaces, and linear operators, and understand basic theories of optimization from intuitive geometrical point of view. Next, mathematical modeling of mechano-systems is discussed for fluid control systems focusing on the relationship between the structure of differential equations and physical phenomena. It is preferable to have basic background on fluid dynamics, control engineering, linear algebra, and analysis.

Nano-and Micro-Surface Metrology and Engineering 2 credits

Elective Required

Professor Wataru Yashiro

Measurement and control are the two wheels of manufacturing. The aim of this lecture is to learn the history of the development of conventional techniques for measurement and control methods covering a wide range of spatial scales from atomic to macroscopic scales of surfaces and interfaces that govern the function of materials. The ultimate goal of this lecture is to develop the ability to analyze for oneself what the limits of conventional measurement and control techniques are, and what problems have been essentially solved to open up new frontiers.

Physical Fluctuomatics 2 credits

Elective Required

Professor Kazuyuki Tanaka

Applications to many fields in engineering like control, signal processing etc. and in information sciences are in mind through the lecture course for the basic knowledge of statistical machine learning theory as well as stochastic processes. Brief introduction will be given to methods for applications like statistical estimation etc., and to the relationship with statistical-mechanical informatics. We first lecture probability and statistics and their fundamental properties and explain the basic frameworks of Bayesian estimation and maximum likelihood estimation. Particularly, we show EM algorithm as one of familiar computational schemes to realize the maximum likelihood estimation. As one of linear statistical models, we introduce Gaussian graphical model and show the explicit procedure for Bayesian estimation and EM algorithm from observed data. We show some useful probabilistic models which are applicable to probabilistic information processing in the standpoint of Bayesian estimation. We mention that some of these models can be regarded as physical models in statistical mechanics. Fundamental structure of belief propagation methods is reviewed as powerful key algorithms to compute some important statistical quantities, for example, averages, variances and covariances. Particularly, we clarify the relationship between belief propagations and some approximate methods in statistical mechanics. As ones of application to probabilistic information processing based on Bayesian estimation and maximum likelihood estimations, we show probabilistic image processing and probabilistic reasoning. Moreover, we review also quantum-mechanical extensions of probabilistic information processing.

Environmental Administration 2 credits

Elective Required

Various teachers

The Graduate School of Environmental Studies has had a cooperation agreement with Miyagi Prefecture and Sendai City, respectively.
In this lecture, students learn about current status and issues related to environmental policies of Miyagi Prefecture and Sendai City (about climate change such as global warming, promotion of waste reduction and recycling including plastic recycling, and environment-related laws) to achieve environmental conservation and sustainable society and learn about environmental policies and environmental technologies.
In addition to lectures, this course can help students acquire practical knowledge and develop their ability to think about how to respond to environmental issues through exercise and facility tour.

Ethics of Engineering and Life 2 credits

Elective Required

Professor Tetsutaro Hattori

We will study wide range of ethical issues including "research ethics", which are important for researchers and engineers. Not only medical science but also engineering is closely related to “life”. Applying some engineering technologies to various fields such as medicine and food productions, we undoubtedly face the matter of life and death in humans and other creatures. The intrinsic influence of engineering is huge, which requires us to acquire sophisticated knowledge and learn the ethical norm. We will invite experts engaged in various fields to give lectures. We will also arrange group discussion and presentation.
*Note for foreign students: Lectures are given in Japanese. In slides and handouts, some lecturers give titles etc. both in Japanese and English, but others do not.

Internship Training 1 or 2 credits

Elective Required

All teachers

Practical training and research conducted at a company for around one week to one month in the first year of master’s program. Through this training, students learn how to apply the basic research at university to a real industrial technology setting. Additionally, students gain on-site experience and understand the realities of planning, surveys and research, product development, manufacturing and product management, etc., in companies. It is desirable that all students take this training. One or two credits are given to them according to the content and the period of the training.

International Scientific Internship Training 1 or 2 credits

Elective Required

All teachers

When students have attended any lectures or practiced in a foreign academic organization or science program, one or two credits are given to them according to the content and the period.

Special Lecture on Finemechanics A 1 or 2 credits

Elective Required
Various teachers

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Advanced Seminar on Finemechanics A 1 or 2 credits

Elective Required
Various teachers

Addressing leading-edge academic research in the major area, this course comprises seminars on a subject which student have chosen themselves as well as training in and beyond the university. Integrating these advanced specialist knowledge helps to develop students' problem-posing ability.

Seminar on Materials and Mechanics 2 credits

Elective Required
Professor Hitoshi Soyama
Professor Hironori Tohmyoh
Professor Takeshi Yamaguchi
Professor Ken Suzuki
Associate Professor Yoshiteru Aoyagi
Associate Professor Keiichi Shirasu
Associate Professor Yoichi Takeda

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Nanomechanics 2 credits

Elective Required
Professor Wei Gao
Professor Taku Ohara
Professor Takashi Tokumasu
Professor Wataru Yashiro
Professor Kazuhiko Endo
Associate Professor Hiraku Matsukuma
Associate Professor Gota Kikugawa
Associate Professor Daichi Chiba
Associate Professor Hikaru Nomura

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Biomechanics 2 credits

Elective Required
Professor Matsuhiko Nishizawa
Professor Takuji Ishikawa
Associate Professor Kenji Kikuchi
Associate Professor Toshihiro Omori

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Intelligent Mechano-Systems 2 credits

Elective Required
Professor Makoto Ohta
Associate Professor Kenichi Funamoto

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Master's Thesis Research in Finemechanics 8 credits

Required
Various teachers

Students engage in experiments and seminars, including research presentations, discussion, and literature reviews. Students who have acquired credits from the Innovation Oriented Seminar on Mechanical Engineering program do not need to take this course.

授業科目表（MC）List of Courses

Department of Robotics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	数値解析学	毎年 Every year	J		2		左記の専門基盤科目の内から４科目以上選択履修し，８単位以上修得すること. A student has to earn 8 or more credits from the Major basic subjects listed in the left column.
	Numerical Analysis	隔年 Every second year	E				
	統計的モデリング Statistical modeling	毎年 Every year	JE		2		
	基盤流体力学	毎年 Every year	J		2		
	Fluid Dynamics	毎年 Every year	E				
	固体力学	毎年 Every year	J		2		
	Solid Mechanics	毎年 Every year	E				
	熱科学・工学A	隔年 Every second year	J		2		
	Thermal Science and Engineering A	隔年 Every second year	E				
	熱科学・工学B	隔年 Every second year	J		2		
	Thermal Science and Engineering B	隔年 Every second year	E				
	システム制御工学Ⅰ System Control Engineering Ⅰ	毎年 Every year	E		2		
	システム制御工学Ⅱ System Control Engineering Ⅱ	毎年 Every year	E		2		
	材料化学 Materials Chemistry	毎年 Every year	E		2		
	計算機科学	隔年 Every second year	J		2		
	Computer Hardware Fundamentals	隔年 Every second year	E				
	固体物理学 Solid State Physics	毎年 Every year	E		2		
	塑性力学 Mechanics of Plasticity	毎年 Every year	E		2		
	生物の構造と機能	隔年 Every second year	J		2		
	Structure and Function Living System	隔年 Every second year	E				
	ロボットビジョン	隔年 Every second year	J		2		
	Robot Vision	隔年 Every second year	E				
	ディジタル信号処理	隔年 Every second year	J		2		
	Digital Signal Processing	隔年 Every second year	E				
	力学と物理数学	隔年 Every second year	J		2		
	Introduction to Classical Mechanics and Physical Mathematics	隔年 Every second year	E				

	連続体力学	隔年 Every second year	J		2		
	Continuum Mechanics	隔年 Every second year	E				
	応用流体力学	隔年 Every second year	J		2		
	Applied Fluid Mechanics	隔年 Every second year	E				
	構造力学	隔年 Every second year	J		2		
	Structural Mechanics	隔年 Every second year	E				
専門科目 Major General Subjects	微小電気機械システム Micro Electro Mechanical Systems	毎年 Every year	E		2		左記の専門科目の内から少なくとも１科目以上選択履修し２単位以上を修得するとともに，左記の科目，特別講義 A，特別研修 A，及び関連科目を選択履修し，全体で１２単位以上を修得すること． Students must earn at least 2 credits from the Major general subjects listed in the left column. In total 12 or more credits are required to earn from the Major general subjects, Special Lecture A, Advanced Seminar A, and related subjects.
	アドバンスドロボティクス Advanced Robotics	隔年 Every second year	E		2		
	バイオメカトロニクス Biomechatronics	隔年 Every second year	J		2		
	分子ロボティクス基礎	隔年 Every second year	J		2		
	Foundations of Molecular Robotics	隔年 Every second year	E				
	知的メカノシステム解析学 Intelligent Mechanosystem Analysis	隔年 Every second year	E		2		
	固体イオニクス論 Introduction to Solid State Ionics	隔年 Every second year	E		2		
	人間－ロボット情報学 Human-Robot Informatics	隔年 Every second year	E		2		
	流体設計情報学 Fluid Design Informatics	隔年 Every second year	E		2		
	ニューロロボティクス Neuro Robotics	隔年 Every second year	E		2		
	知能制御システム学 Intelligent Control Systems	隔年 Every second year	E		2		
	機能性流体工学 Functional Fluids Engineering	隔年 Every second year	E		2		
	ナノ・マイクロメカノプティクス Nano/Micro Mechanoptics	隔年 Every second year	E		2		
	タフ・サイバーフィジカル AI 学 Tough Cyberphysical AI	隔年 Every second year	J		2		
	物理フラクチュオマティクス論 Physical Fluctuomatics	毎年 Every year	J		2		
	環境行政論 Environmental Administration	毎年 Every year	J		2		
	工学と生命の倫理 Ethics of Engineering and Life	毎年 Every year	JE		2		
	インターンシップ研修 Internship Training				1~2		
	国際学術インターンシップ研修 International Scientific InternshipTraining				1~2		

	ロボティクス特別講義A Special Lecture on Robotics A				1~2		特別講義A, 特別研修Aで修得した単位は２単位まで専門科目の要件の 12 単位に含めることができる. なお, ダブルディグリープログラム, 共同教育プログラムの学生に限り, 特別講義 A の単位を８単位まで本要件に含めることができる. A total of 2 credits at most, obtained from Special Lecture A and/or Advanced Seminar A, can be included in the requirement of 12 credits. As an exception, students enrolled in the double-degree program or joint educational program can include up to 8 credits from Special Lecture A.
	ロボティクス特別研修A Advanced Seminar on Robotics A				1~2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	ナノシステムセミナー Seminar on Nano-Systems	毎年 Every year	JE		2		左記のセミナーのうちから, 指導教員の所属するセミナー２単位を修得すること. Students must earn 2 credits from one of their supervisor's seminars listed in the left column.
	ロボットシステムセミナー Seminar on Robot-Systems	毎年 Every year	JE		2		
	ロボティクス修士研修 Master's Thesis Research in Robotics			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Numerical Analysis 2 credits
Elective Required
Professor Naofumi Ohnishi

Students will be taught the numerical analysis techniques which provide the basis for analysis in fluid dynamics, thermodynamics, mechanics, electromagnetics and measurement and control engineering, etc., and learn how to apply these skills. Classes will focus in particular on (1) numerical solutions for ordinary differential equations (2) the finite difference method and the finite element method for partial differential equations, and (3) linear algebra and numerical optimization methods, covering the basics of numerical analysis and their engineering applications.

Statistical modeling 2 credits
Elective Required
Professor Yuko Araki

Statistical modeling is widely used in various fields of natural and social sciences to extract information from data and to solve problems. In this lectures, we will start from the basic theory underlying statistical modeling of phenomena , and then focuses on (1) how to set up flexible models, (2)how to estimate parameters of models, and (3) how to select optimal models in order to efficiently extract information from recent data with complex and diverse structures.
Background knowledge on elementary probability and statistics are required.

Fluid Dynamics 2 credits
Elective Required
Professor Masaya Shigeta

Students acquire the intuition and knowledge of the nature of fluid motion by studying the fundamentals of Fluid Dynamics with not only theories but also visualized images, observation videos, and computer graphic animations. The goal is for students to be able to predict the fluid motion and to design the control methods in aerodynamic and material processing applications. Students can also improve their abilities of scientific discussion and international communication. Keywords: Vortex, Stream/Path/Streak lines, Incompressibility/Compressibility, Conservation laws, Bernoulli's theorem, Viscosity and diffusivity, Boundary layer, Aerodynamic force, Laws of similarity, Reynolds number, Strouhal number and Kármán's vortex street, Navier-Stokes and wave equations, Analogy with heat and mass transfers, and Plasma as high-temperature chemically-reactive electromagnetic fluid.

Solid Mechanics 2 credits
Elective Required
Associate Professor Yoshiteru Aoyagi

This class is designed to provide students with a comprehensive understanding of deformation of solids and covers the fundamentals of continuum solid mechanics. It focuses on two-dimensional elasticity in infinitesimal strain theory, the concept of strain and stress, and the introduction of general methods of solving the boundary value problems through the specific problems. Moreover, this class also covers the fundamentals of finite deformation theory, which is used for addressing the large deformations of solids.

Thermal Science and Engineering A 2 credits
Elective Required
Professor Kaoru Maruta
Professor Takashi Tokumasu
Associate Professor Hisashi Nakamura
Associate Professor Akihiro Hayakawa

In this course, students will master the fundamentals of reactive flows in thermal fluid science. In particular, the course is designed to cover flame behaviors and peculiar phenomena in laminar and turbulent combustion, the basic concept of chemical kinetics and the understanding of reaction phenomena of electrochemistry on the standpoint of thermal science. Through the class, students will further deepen their understanding of the essence of thermal phenomena and will become able to apply this to practical devices.

Thermal Science and Engineering B 2 credits
Elective Required
Professor Taku Ohara
Professor Tetsushi Biwa
Professor Atsuki Komiya
Associate Professor Gota Kikugawa
Associate Professor Eita Shoji

The students will master the basic physics of thermal energy conversion and heat transfer in both micro and macroscopic scales and learn to link this knowledge to engineering applications. More specifically, the series lectures: i) the Molecular Dynamics and molecular-scale analyses of thermo-fluid phenomena, ii) oscillating-flow based heat transfer and energy conversion, iii) visualization and control of multi-scale heat and mass transfer, and iv) statistical mechanics regarding interface phenomena will be done. Students are expected to further deepen their understanding of the essence of thermal phenomena.

System Control Engineering I 2 credits
Elective Required
Professor Koichi Hashimoto
Professor Yasuhisa Hirata

New mechanical systems using advanced mechanisms are being developed in a range of areas for medical care and welfare, space exploration, disaster rescue purposes and so on. This course focuses on motion control design of increasingly advanced and complex mechanical systems. Students will learn fundamentals for non-linear system analysis and control system design methods. First, phase plane analysis methods and Lyapunov methods are introduced as the main ways to analyze non-linear systems. Next, non-linear feedback control system design methods that can be used for mechanical control systems with non-linear dynamics. Finally, students look at several control system design methods.

System Control Engineering II 2 credits
Elective Required
Professor Kazuya Yoshida
Associate Professor Yusuke Tamura

This course gives an advanced lecture based on the contents of "System Control Engineering I." This lecture introduces the analysis and design methods of control systems used for designing motion control for increasingly advanced and complex mechanical systems. Students will learn fundamental concepts for state and output feedback in the state space, state observer and Kalman filter, and response analysis of control systems. This class includes some exercises using MATLAB.

Materials Chemistry 2 credits Elective Required Professor Yutaka Watanabe Professor Koji Amezawa Professor Eiji Akiyama Associate Professor Yoichi Takeda Most metals in the earth's atmosphere inevitably change into more thermodynamically stable compounds such as oxides or sulfides. To understand this principle more precisely, students will learn chemical and electro-chemical equilibrium theory, and kinetics theory in relation to corrosion and oxidation of metals. Practical examples will be used to explain the phenomena and theories of wet corrosion and high-temperature oxidation, deepening students' understanding of the chemical and electro-chemical reactions related to macro phenomena of corrosion and oxidation. This course will be offered in English with a lecture and practice style, using English-language materials. A detailed outline of the course will be presented during the first class.	**Computer Hardware Fundamentals** 2 credits Elective Required Professor Tetsu Tanaka Professor Hiroyuki Takizawa Computers have become an indispensable part of modern society. In this course, both IC technology and computer architecture will be lectured for a better understanding of modern computer systems. First, CMOS-IC technology, memory technology, and 2D/3D integration technology that support a remarkable evolution of computer systems over the past few decades will be introduced. Then, the topics will move to computer architecture focusing on the structure of computer systems, issues and tradeoffs involved in the design of computer system architecture, and high-performance computing. Also, research topics on state-of-the-art IC technology and computer architecture will be presented in the lecture.
Solid State Physics 2 credits Elective Required Professor Hiroo Yugami Professor Takahito Ono Professor Ying Chen This course targets students from mechanical engineering, system engineering and a wide range of other specialized areas. Using Introduction to Solid State Physics (Charles Kittel, Eighth Edition) as the main text, it focuses on the fundamentals of material science. Following the chapter order in this textbook, each class will cover the content associated with that chapter. The course aims to provide students from a wide range of areas with an understanding of the basics concept of solid-state physics and a broad perspective on the behavior of materials in engineering systems.	**Mechanics of Plasticity** 2 credits Elective Required Associate Professor Yoshiteru Aoyagi Mechanics of plasticity is an extended subject of mechanics of materials, mechanics of elasticity, continuum mechanics, and solid mechanics. This lecture aims to understand the mechanical description of "plastic deformation," a fundamental phenomenon such as the strength and fracture of materials, forming process, and tribology, and to master a deformation analysis method based on plasticity. This lecture covers 1) basic concepts of plastic deformation, 2) a mechanical description of plastic deformation, 3) a simulation method using the finite element method, and 4) applications to engineering through examples.
Structure and Function of Living System 2 credits Elective Required Professor Yoichi Haga Professor Makoto Ohta Professor Takuji Ishikawa In all types of engineering with a connection to the human body, a thorough understanding of the structure and function of the human body and other living systems is vital, as is consideration of systems geared to the special features of these living systems. This course covers the biology knowledge in terms of the basic functions and structures of living organisms that forms the basis of bioengineering. Particular emphasis will be placed on the basic knowledge and approaches necessary for deep exploration of the anatomy and physiology of the human body from the perspective of biomechanics.	**Robot Vision** 2 credits Elective Required Professor Takayuki Okatani This course explains various problems and their solutions in computer vision. The problems are basically inverse problems in which we wish to estimate some information about an object or a scene from their image(s), such as the three-dimensional shape of a scene or the categories of object. Students will first learn a series of fundamental concepts, and then study a number of approaches to the problems of computer vision, where the main focus is on the recently developed deep learning methods.

Digital Signal Processing 2 credits
Elective Required
Professor Shingo Kagami
Associate Professor Toshinori Kuwahara

This lecture covers fundamentals of digital signal processing that provides a foundation for sensing, control, communication, voice processing, image processing, and so forth. Related subjects include discrete-time signals, discrete-time and discrete Fourier transformations, sampling, digital frequency analysis, discrete-time systems, z transformation, digital filtering, and some more advanced topics.

Introduction to Mechanics and Physical Mathematics 2 credits
Elective Required
Professor Tomonaga Okabe

In the modeling of classical mechanics, we often meet the applied mathematics, such as differential geometry or manifolds theory. These have been developed from the viewpoint of mathematical universality and do not always provide new ideas directly. But, we often need such a background to make the theoretical models. Furthermore, symbols and calculations developed in these fields are not commonly used by general engineering students or graduate students of engineering, and this is considered to be an obstacle for learning them. In this lecture, I am going to introduce those mathematical expressions as simple as possible, so that the students can employ the advanced mathematics in the general mechanical engineering field. This course can also be considered as an introduction to the tools of physical mathematics.

Continuum Mechanics 2 credits
Elective Required
Professor Takuji Ishikawa
Associate Professor Toshihiro Omori

Materials may be regarded as continuum at the macroscopic scale. In this lecture, we aim to mathematically understand the motion and deformation of materials, such as solid and fluid, at the macroscopic scale. We first explain the concepts of continuum and stress as well as vector/tensor analysis. We then derive basic equations describing the motion and deformation of continuum, such as equilibrium equation, constitutive equation and boundary conditions. This lecture is the basis of solid and fluid mechanics, which is recommended to students who want to establish a whole picture of both subjects.

Applied Fluid Mechanics 2 credits
Elective Required
Professor Jun Ishimoto
Professor Yuka Iga

This lecture will be given on the fundamentals and applications of multiphase fluid dynamics and numerical analysis related to the fluid dynamic phenomena with heterogeneous interfaces, gas-liquid two-phase flow, phase change, cavitation, and the fundamentals of turbo-type fluid machinery such as pumps and turbines. The main topics to be understand are as follows. 1) Flow pattern and classification method of gas-liquid two-phase flow, 2) Fundamentals of two-fluid model, 3) Modeling of dispersed multi-phase flow and numerical analysis, 4) Modeling of liquid atomization 5) Classification and role of fluid machinery 6) Generation of cavitation in pumps.

Structural Mechanics 2 credits
Elective Required
Professor Kanjuro Makihara
Associate Professor Keisuke Otsuka

This lecture gives a fundamental knowledge on the structural analysis and the structural design of mechanical structures. Main topics of this lecture are deformation and stress analyses of fuselage and wing structures subjected to bending, twisting and shear. (1) Fundamental of mechanical structure and material strength. (2) Vibration analysis for structures. (3) Applied load and stress analysis of mechanical structures. (4) Structural identification and structural health monitoring (5) Structural mechanics for aerospace engineering.

Micro Electro Mechanical Systems 2 credits
Elective Required
Professor Shuji Tanaka
Associate Professor Takashiro Tsukamoto

This course deals with key components and microfabrication technology for bio-mechanodevices, which are used for human interface, advanced robotics, biomedical applications, wireless communication etc. Important key components such as sensors, actuators and packaging are overviewed together with related materials and typical applications. Microfabrication technology is explained in detail. The topics include wet/dry etching, physical/chemical vapor deposition, lithography, diffusion, oxidation, electroplating and wafer bonding. The lecture is given in practical aspects as well as fundamental aspects for who is studying microdevices and a wide range of related technology.

Advanced Robotics 2 credits
Elective Required
Professor Yasuhisa Hirata
Associate Professor Yusuke Tamura

The robot is an advanced system that consists of mechanical parts, actuators, sensors, and controllers. By integrating the several systems and control methods effectively, the robot could realize required tasks in the real environment. In this lecture, the fundamental and advanced motion control methods of the robot will be given, and the recent applications developed by the integration of the robot technologies will be introduced.

Biomechatronics 2 credits
Elective Required
Professor Mami Tanaka

Foundations of Molecular Robotics 2 credits
Elective Required
Professor Satoshi Murata
Associate Professor Shinichiro Nomura

Molecular robotics is a technology for creating systems by combining logically designed molecules. The basis of molecular robotics are DNA nanotechnology and artificial cell engineering. DNA nanotechnology is used to create various nanostructures and molecular computers for molecular robot by designing the sequences of nucleic acid molecules such as DNA. Artificial cell engineering is a methodology to embed various functional molecules in vesicles called liposomes to create a cellular molecular robot. In addition, synthetic biology, which is a closely related subject to molecular robotics, will also be explained.

Intelligent Mechanosystem Analysis 2 credits
Elective Required
Elective Required
Associate Professor Kenichi Funamoto

Intelligent mechano-systems are generally modeled as infinite-dimensional nonlinear dynamical systems. As a basis of modern control theory to deal with such systems, we first study basic concepts of function spaces, dual spaces, and linear operators, and understand basic theories of optimization from intuitive geometrical point of view. Next, mathematical modeling of mechano-systems is discussed for fluid control systems focusing on the relationship between the structure of differential equations and physical phenomena. It is preferable to have basic background on fluid dynamics, control engineering, linear algebra, and analysis.

Introduction to Solid State Ionics 2 credits
Elective Required
Professor Koji Amezawa
Associate Professor Kazuhisa Sato

In this lecture, ionic transport phenomena in solids will be discussed. Ions in ceramics, ionic crystals, and inorganic glasses can move in varying degrees. Particularly solids showing excellent ionic conduction are called as solid state ionic conductors, and utilized as electrolytes or electrodes of fuel cells, batteries, and electrochemical sensors. In this lecture, basics of solid state ionics, such as mechanisms of ionic conduction in solid, will be first explained, and then advanced applications of solid state ionic conductors will be introduced.

Human-Robot Informatics 2 credits
Elective Required
Professor Satoshi Tadokoro
Professor Kazunori Ohno
Associate Professor Masashi Konyo

Lectures and investigation study on the following themes.
1) Disaster response robotics
2) Haptic interface
3) Field robotics
4) Advanced mechanisms

Fluid Design Informatics 2 credits
Elective Required
Professor Shigeru Obayashi

This lecture aims to construct the theories, learn the methodologies, and see the real-world examples of fluid engineering design, which is based on computational fluid dynamics (CFD) combined with information science. The lecture outline is organized as 1. design optimization, 2. gradient method, 3. evolutionary computation, 4. surrogate model, 5. physics-based optimization, and 6. data mining.

Neuro Robotics 2 credits Elective Required Professor Mitsuhiro Hayashibe Associate Professor Dai Owaki This course deals with key elements for Neuro-Robotics which is new scientific field to use robotics for neuroscience and use neuroscience for robotics. We learn robotics computation aspect and neuroscience knowledge to understand human functionality with the view of robotics, and robotics modeling and computation technology which is useful to understand human system of motor control and motor learning. It may include machine learning, neural network, Kalman filtering, control methods for computation aspect. The lecture is given in practical aspects as well as fundamental aspects for students who study neurorobotics and its related applications.	**Intelligent Control Systems** 2 credits Elective Required Professor Koichi Hashimoto Professor Shingo Kagami The aim of this lecture is to obtain the basics knowledge and to know the latest trend for intelligent control systems. Lectures on robot kinematics, robot vision, and feedback control theory will be given. Lectures on building blocks for robot vision systems such as image sensors, image processing and visual tracking will also be given.
Functional Fluids Engineering 2 credits Elective Required Professor Takehiko Sato Professor Masaya Shigeta Professor Hidemasa Takana This course covers fluids that express functionality depending by external fields. We discuss fundamentals of fluids' structure, mechanism of exhibiting the functionalities, transport phenomena, governing equations, and diagnostic method for the functional fluids such as plasma fluid, magnetic fluid, MR or ER fluids, ionic liquid. Also, regarding advanced applications using functionalities of those fluids, we outline plasma medicine, environmental remediation, material processing, energy equipment and other topics.	**Nano/Micro Mechanoptics** 2 credits Elective Required Professor Yoshiaki Kanamori Associate Professor Naoki Inomata Mechanoptics is the fusional research field of optics and mechanics. Nano/Micro mechanoptics is a research field of mechanoptics on nano/micrometer scales. Fundamental technologies and applications in the field are surveyed. The topics on micrometer scale are spatial modulators for displays, micromechanical systems for optical telecommunication, optical sensors, etc. The topics on nanometer scale are wavelength-selective optical filters using subwavelength mechanical structures, optical devices for controlling surface optical reflectance and light polarization, and structural optics smaller than the subwavelength optics. Micro/Nanometer scale fabrication technologies for micro/nano mechanoptics are also studied. The latest papers relating to the above are also presented and discussed.

Tough Cyberphysical AI 2 credits

Elective Required

Professor Kazunori Ohno

The importance of cyberphysical AI that operates in the real world with embodiment is rapidly growing. In order to contribute to solving issues that our society faces such as SDGs and disasters, with the central issues of system robustness, flexibility, adaptability, and wide applicability, this course will give lectures, exercises, and discussions on advanced research of tough cyberphysical AI such as tough robotics, intelligence operating in extreme environments, and their advancement.

Physical Fluctuomatics 2 credits

Elective Required

Professor Kazuyuki Tanaka

Applications to many fields in engineering like control, signal processing etc. and in information sciences are in mind through the lecture course for the basic knowledge of statistical machine learning theory as well as stochastic processes. Brief introduction will be given to methods for applications like statistical estimation etc., and to the relationship with statistical-mechanical informatics. We first lecture probability and statistics and their fundamental properties and explain the basic frameworks of Bayesian estimation and maximum likelihood estimation. Particularly, we show EM algorithm as one of familiar computational schemes to realize the maximum likelihood estimation. As one of linear statistical models, we introduce Gaussian graphical model and show the explicit procedure for Bayesian estimation and EM algorithm from observed data. We show some useful probabilistic models which are applicable to probabilistic information processing in the standpoint of Bayesian estimation. We mention that some of these models can be regarded as physical models in statistical mechanics. Fundamental structure of belief propagation methods is reviewed as powerful key algorithms to compute some important statistical quantities, for example, averages, variances and covariances. Particularly, we clarify the relationship between belief propagations and some approximate methods in statistical mechanics. As ones of application to probabilistic information processing based on Bayesian estimation and maximum likelihood estimations, we show probabilistic image processing and probabilistic reasoning. Moreover, we review also quantum-mechanical extensions of probabilistic information processing.

Environmental Administration 2 credits

Elective Required

Various teachers

The Graduate School of Environmental Studies has had a cooperation agreement with Miyagi Prefecture and Sendai City, respectively.
In this lecture, students learn about current status and issues related to environmental policies of Miyagi Prefecture and Sendai City (about climate change such as global warming, promotion of waste reduction and recycling including plastic recycling, and environment-related laws) to achieve environmental conservation and sustainable society and learn about environmental policies and environmental technologies.

In addition to lectures, this course can help students acquire practical knowledge and develop their ability to think about how to respond to environmental issues through exercise and facility tour.

Ethics of Engineering and Life 2 credits

Elective Required

Professor Tetsutaro Hattori

We will study wide range of ethical issues including "research ethics", which are important for researchers and engineers. Not only medical science but also engineering is closely related to "life". Applying some engineering technologies to various fields such as medicine and food productions, we undoubtedly face the matter of life and death in humans and other creatures. The intrinsic influence of engineering is huge, which requires us to acquire sophisticated knowledge and learn the ethical norm. We will invite experts engaged in various fields to give lectures. We will also arrange group discussion and presentation.
*Note for foreign students: Lectures are given in Japanese. In slides and handouts, some lecturers give titles etc. both in Japanese and English, but others do not.

Internship Training 1 or 2 credits

Elective Required

All teachers

Practical training and research conducted at a company for around one week to one month in the first year of master's program. Through this training, students learn how to apply the basic research at university to a real industrial technology setting. Additionally, students gain on-site experience and understand the realities of planning, surveys and research, product development, manufacturing and product management, etc., in companies. It is desirable that all students take this training. One or two credits are given to them according to the content and the period of the training.

International Scientific Internship Training 1 or 2 credits

Elective Required

All teachers

When students have attended any lectures or practiced in a foreign academic organization or science program, one or two credits are given to them according to the content and the period.

Special Lecture on Robotics A 1 or 2 credits Elective Required Various teachers A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.	**Advanced Seminar on Robotics A** 1 or 2 credits Elective Required Various teachers Addressing leading-edge academic research in the major area, this course comprises seminars on a subject which student have chosen themselves as well as training in and beyond the university. Integrating these advanced specialist knowledge helps to develop students' problem-posing ability.
Seminar on Nano-Systems 2 credits Elective Required Professor Shuji Tanaka Professor Satoshi Murata Professor Yoichi Haga Professor Yoshiaki Kanamori Associate Professor Shinichiro Nomura Associate Professor Takaki Tsukamoto Associate Professor Naoki Inomata Associate Professor Takuya Mabuchi By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.	**Seminar on Robot-Systems** 2 credits Elective Required Professor Mami Tanaka Professor Mitsuhiro Hayashibe Professor Yasuhisa Hirata Associate Professor Takeshi Okuyama Associate Professor Dai Owaki Associate Professor Yusuke Tamura By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.
Master's Thesis Research in Robotics 8 credits Required Various teachers Students engage in experiments and seminars, including research presentations, discussion, and literature reviews. Students who have acquired credits from the Innovation Oriented Seminar on Mechanical Engineering program do not need to take this course.	

授業科目表（MC）List of Courses

Department of Aerospace Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	選択必須 Elective Required	選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	数値解析学	毎年 Every year	J		2		左記の専門基盤科目の内から４科目以上選択履修し，８単位以上修得すること. A student has to earn 8 or more credits from the Major basic subjects listed in the left column.
	Numerical Analysis	隔年 Every second year	E				
	統計的モデリング Statistical modeling	毎年 Every year	JE		2		
	基盤流体力学	毎年 Every year	J		2		
	Fluid Dynamics	毎年 Every year	E				
	固体力学	毎年 Every year	J		2		
	Solid Mechanics	毎年 Every year	E				
	熱科学・工学Ａ	隔年 Every second year	J		2		
	Thermal Science and Engineering A	隔年 Every second year	E				
	熱科学・工学Ｂ	隔年 Every second year	J		2		
	Thermal Science and Engineering B	隔年 Every second year	E				
	システム制御工学Ⅰ System Control Engineering Ⅰ	毎年 Every year	E		2		
	システム制御工学Ⅱ System Control Engineering Ⅱ	毎年 Every year	E		2		
	材料化学 Materials Chemistry	毎年 Every year	E		2		
	計算機科学	隔年 Every second year	J		2		
	Computer Hardware Fundamentals	隔年 Every second year	E				
	固体物理学 Solid State Physics	毎年 Every year	E		2		
	塑性力学 Mechanics of Plasticity	毎年 Every year	E		2		
	生物の構造と機能	隔年 Every second year	J		2		
	Structure and Function Living System	隔年 Every second year	E				
	ロボットビジョン	隔年 Every second year	J		2		
	Robot Vision	隔年 Every second year	E				
	ディジタル信号処理	隔年 Every second year	J		2		
	Digital Signal Processing	隔年 Every second year	E				
	力学と物理数学	隔年 Every second year	J		2		
	Introduction to Classical Mechanics and Physical Mathematics	隔年 Every second year	E				

	連続体力学	隔年 Every second year	J		2		
	Continuum Mechanics	隔年 Every second year	E				
	応用流体力学	隔年 Every second year	J		2		
	Applied Fluid Mechanics	隔年 Every second year	E				
	構造力学	隔年 Every second year	J		2		
	Structural Mechanics	隔年 Every second year	E				
専門科目 Major General Subjects	航空宇宙システム工学 Aerospace Systems	毎年 Every year	J		2		左記の専門科目の内から少なくとも１科目以上選択履修し２単位以上を修得するとともに，左記の科目，特別講義 A，特別研修 A，及び関連科目を選択履修し，全体で１２単位以上を修得すること． Students must earn at least 2 credits from the Major general subjects listed in the left column. In total 12 or more credits are required to earn from the Major general subjects, Special Lecture A, Advanced Seminar A, and related subjects.
	航空宇宙推進工学	隔年 Every second year	J		2		
	Aerospace Propulsion	隔年 Every second year	E				
	数値流体力学 Computational Fluid Dynamics	隔年 Every second year	E		2		
	宇宙探査ロボティクス Robotics for Space Exploration	毎年 Every year	E		2		
	衛星工学 Spacecraft Engineering	毎年 Every year	E		2		
	計算数理科学 Mathematical Modeling and Computation	毎年 Every year	E		2		
	数理流体力学	隔年 Every second year	J		2		
	Applied Mathematical Fluid Dynamics	隔年 Every second year	E				
	高性能計算論 High Performance Computing	毎年 Every year	E		2		
	流体設計情報学 Fluid Design Informatics	隔年 Every second year	E		2		
	アーキテクチャ学 Computer Architecture	毎年 Every year	E		2		
	物理フラクチュオマティクス論 Physical Fluctuomatics	毎年 Every year	J		2		
	環境行政論 Environmental Administration	毎年 Every year	J		2		
	工学と生命の倫理 Ethics of Engineering and Life	毎年 Every year	JE		2		
	JAXA 連携特別講義 Special Lecture in Cooperation with JAXA	Note1	E		2		
	インターンシップ研修 Internship Training				1~2		
	国際学術インターンシップ研修 International Scientific Internship Training				1~2		

	航空宇宙工学特別講義Ａ Special Lecture on Aerospace Engineering A				1~2		特別講義 A, 特別研修 A で修得した単位は２単位まで専門科目の要件の 12 単位に含めることができる. なお, ダブルディグリープログラム, 共同教育プログラムの学生に限り, 特別講義 A の単位を８単位まで本要件に含めることができる. A total of 2 credits at most, obtained from Special Lecture A and/or Advanced Seminar A, can be included in the requirement of 12 credits. As an exception, students enrolled in the double-degree program or joint educational program can include up to 8 credits from Special Lecture A.
	航空宇宙工学特別研修Ａ Advanced Seminar on Aerospace Engineering A				1~2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	航空システムセミナー Seminar on Aero Systems	毎年 Every year	JE		2		左記のセミナーのうちから, 指導教員の所属するセミナー２単位を修得すること. Students must earn 2 credits from one of their supervisor's seminars listed in the left column.
	宇宙システムセミナー Seminar on Space Systems	毎年 Every year	JE		2		
	航空宇宙工学修士研修 Master's Thesis Research in Aeronautics and Space Engineering			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Note 1) Please contact the instructor for details.

Numerical Analysis 2 credits

Elective Required

Professor Naofumi Ohnishi

Students will be taught the numerical analysis techniques which provide the basis for analysis in fluid dynamics, thermodynamics, mechanics, electromagnetics and measurement and control engineering, etc., and learn how to apply these skills. Classes will focus in particular on (1) numerical solutions for ordinary differential equations (2) the finite difference method and the finite element method for partial differential equations, and (3) linear algebra and numerical optimization methods, covering the basics of numerical analysis and their engineering applications.

Statistical modeling 2 credits

Elective Required

Professor Yuko Araki

Statistical modeling is widely used in various fields of natural and social sciences to extract information from data and to solve problems. In this lectures, we will start from the basic theory underlying statistical modeling of phenomena , and then focuses on (1) how to set up flexible models, (2)how to estimate parameters of models, and (3) how to select optimal models in order to efficiently extract information from recent data with complex and diverse structures.

Background knowledge on elementary probability and statistics are required.

Fluid Dynamics 2 credits

Elective Required

Professor Masaya Shigeta

Students acquire the intuition and knowledge of the nature of fluid motion by studying the fundamentals of Fluid Dynamics with not only theories but also visualized images, observation videos, and computer graphic animations. The goal is for students to be able to predict the fluid motion and to design the control methods in aerodynamic and material processing applications. Students can also improve their abilities of scientific discussion and international communication. Keywords: Vortex, Stream/Path/Streak lines, Incompressibility/Compressibility, Conservation laws, Bernoulli's theorem, Viscosity and diffusivity, Boundary layer, Aerodynamic force, Laws of similarity, Reynolds number, Strouhal number and Kármán's vortex street, Navier-Stokes and wave equations, Analogy with heat and mass transfers, and Plasma as high-temperature chemically-reactive electromagnetic fluid.

Solid Mechanics 2 credits

Elective Required

Associate Professor Yoshiteru Aoyagi

This class is designed to provide students with a comprehensive understanding of deformation of solids and covers the fundamentals of continuum solid mechanics. It focuses on two-dimensional elasticity in infinitesimal strain theory, the concept of strain and stress, and the introduction of general methods of solving the boundary value problems through the specific problems. Moreover, this class also covers the fundamentals of finite deformation theory, which is used for addressing the large deformations of solids.

Thermal Science and Engineering A 2 credits

Elective Required

Professor Kaoru Maruta

Professor Takashi Tokumasu

Associate Professor Hisashi Nakamura

Associate Professor Akihiro Hayakawa

In this course, students will master the fundamentals of reactive flows in thermal fluid science. In particular, the course is designed to cover flame behaviors and peculiar phenomena in laminar and turbulent combustion, the basic concept of chemical kinetics and the understanding of reaction phenomena of electrochemistry on the standpoint of thermal science. Through the class, students will further deepen their understanding of the essence of thermal phenomena and will become able to apply this to practical devices.

Thermal Science and Engineering B 2 credits

Elective Required

Professor Taku Ohara

Professor Tetsushi Biwa

Professor Atsuki Komiya

Associate Professor Gota Kikugawa

Associate Professor Eita Shoji

The students will master the basic physics of thermal energy conversion and heat transfer in both micro and macroscopic scales and learn to link this knowledge to engineering applications. More specifically, the series lectures: i) the Molecular Dynamics and molecular-scale analyses of thermo-fluid phenomena, ii) oscillating-flow based heat transfer and energy conversion, iii) visualization and control of multi-scale heat and mass transfer, and iv) statistical mechanics regarding interface phenomena will be done. Students are expected to further deepen their understanding of the essence of thermal phenomena.

System Control Engineering I 2 credits

Elective Required

Professor Koichi Hashimoto

Professor Yasuhisa Hirata

New mechanical systems using advanced mechanisms are being developed in a range of areas for medical care and welfare, space exploration, disaster rescue purposes and so on. This course focuses on motion control design of increasingly advanced and complex mechanical systems. Students will learn fundamentals for non-linear system analysis and control system design methods. First, phase plane analysis methods and Lyapunov methods are introduced as the main ways to analyze non-linear systems. Next, non-linear feedback control system design methods that can be used for mechanical control systems with non-linear dynamics. Finally, students look at several control system design methods.

System Control Engineering II 2 credits

Elective Required

Professor Kazuya Yoshida

Associate Professor Yusuke Tamura

This course gives an advanced lecture based on the contents of "System Control Engineering I." This lecture introduces the analysis and design methods of control systems used for designing motion control for increasingly advanced and complex mechanical systems. Students will learn fundamental concepts for state and output feedback in the state space, state observer and Kalman filter, and response analysis of control systems. This class includes some exercises using MATLAB.

Materials Chemistry 2 credits
Elective Required
Professor Yutaka Watanabe
Professor Koji Amezawa
Professor Eiji Akiyama
Associate Professor Yoichi Takeda

Most metals in the earth's atmosphere inevitably change into more thermodynamically stable compounds such as oxides or sulfides. To understand this principle more precisely, students will learn chemical and electro-chemical equilibrium theory, and kinetics theory in relation to corrosion and oxidation of metals. Practical examples will be used to explain the phenomena and theories of wet corrosion and high-temperature oxidation, deepening students' understanding of the chemical and electro-chemical reactions related to macro phenomena of corrosion and oxidation. This course will be offered in English with a lecture and practice style, using English-language materials. A detailed outline of the course will be presented during the first class.

Computer Hardware Fundamentals 2 credits
Elective Required
Professor Tetsu Tanaka
Professor Hiroyuki Takizawa

Computers have become an indispensable part of modern society. In this course, both IC technology and computer architecture will be lectured for a better understanding of modern computer systems. First, CMOS-IC technology, memory technology, and 2D/3D integration technology that support a remarkable evolution of computer systems over the past few decades will be introduced. Then, the topics will move to computer architecture focusing on the structure of computer systems, issues and tradeoffs involved in the design of computer system architecture, and high-performance computing. Also, research topics on state-of-the-art IC technology and computer architecture will be presented in the lecture.

Solid State Physics 2 credits
Elective Required
Professor Hiroo Yugami
Professor Takahito Ono
Professor Ying Chen

This course targets students from mechanical engineering, system engineering and a wide range of other specialized areas. Using Introduction to Solid State Physics (Charles Kittel, Eighth Edition) as the main text, it focuses on the fundamentals of material science. Following the chapter order in this textbook, each class will cover the content associated with that chapter. The course aims to provide students from a wide range of areas with an understanding of the basics concept of solid-state physics and a broad perspective on the behavior of materials in engineering systems.

Mechanics of Plasticity 2 credits
Elective Required
Associate Professor Yoshiteru Aoyagi

Mechanics of plasticity is an extended subject of mechanics of materials, mechanics of elasticity, continuum mechanics, and solid mechanics. This lecture aims to understand the mechanical description of "plastic deformation," a fundamental phenomenon such as the strength and fracture of materials, forming process, and tribology, and to master a deformation analysis method based on plasticity. This lecture covers 1) basic concepts of plastic deformation, 2) a mechanical description of plastic deformation, 3) a simulation method using the finite element method, and 4) applications to engineering through examples.

Structure and Function of Living System 2 credits
Elective Required
Professor Yoichi Haga
Professor Makoto Ohta
Professor Takuji Ishikawa

In all types of engineering with a connection to the human body, a thorough understanding of the structure and function of the human body and other living systems is vital, as is consideration of systems geared to the special features of these living systems. This course covers the biology knowledge in terms of the basic functions and structures of living organisms that forms the basis of bioengineering. Particular emphasis will be placed on the basic knowledge and approaches necessary for deep exploration of the anatomy and physiology of the human body from the perspective of biomechanics.

Robot Vision 2 credits
Elective Required
Professor Takayuki Okatani

This course explains various problems and their solutions in computer vision. The problems are basically inverse problems in which we wish to estimate some information about an object or a scene from their image(s), such as the three-dimensional shape of a scene or the categories of object. Students will first learn a series of fundamental concepts, and then study a number of approaches to the problems of computer vision, where the main focus is on the recently developed deep learning methods.

Digital Signal Processing 2 credits
Elective Required
Professor Shingo Kagami
Associate Professor Toshinori Kuwahara

This lecture covers fundamentals of digital signal processing that provides a foundation for sensing, control, communication, voice processing, image processing, and so forth. Related subjects include discrete-time signals, discrete-time and discrete Fourier transformations, sampling, digital frequency analysis, discrete-time systems, z transformation, digital filtering, and some more advanced topics.

Introduction to Mechanics and Physical Mathematics 2 credits
Elective Required
Professor Tomonaga Okabe

In the modeling of classical mechanics, we often meet the applied mathematics, such as differential geometry or manifolds theory. These have been developed from the viewpoint of mathematical universality and do not always provide new ideas directly. But, we often need such a background to make the theoretical models. Furthermore, symbols and calculations developed in these fields are not commonly used by general engineering students or graduate students of engineering, and this is considered to be an obstacle for learning them. In this lecture, I am going to introduce those mathematical expressions as simple as possible, so that the students can employ the advanced mathematics in the general mechanical engineering field. This course can also be considered as an introduction to the tools of physical mathematics.

Continuum Mechanics 2 credits
Elective Required
Professor Takuji Ishikawa
Associate Professor Toshihiro Omori

Materials may be regarded as continuum at the macroscopic scale. In this lecture, we aim to mathematically understand the motion and deformation of materials, such as solid and fluid, at the macroscopic scale. We first explain the concepts of continuum and stress as well as vector/tensor analysis. We then derive basic equations describing the motion and deformation of continuum, such as equilibrium equation, constitutive equation and boundary conditions. This lecture is the basis of solid and fluid mechanics, which is recommended to students who want to establish a whole picture of both subjects.

Applied Fluid Mechanics 2 credits
Elective Required
Professor Jun Ishimoto
Professor Yuka Iga

This lecture will be given on the fundamentals and applications of multiphase fluid dynamics and numerical analysis related to the fluid dynamic phenomena with heterogeneous interfaces, gas-liquid two-phase flow, phase change, cavitation, and the fundamentals of turbo-type fluid machinery such as pumps and turbines. The main topics to be understand are as follows. 1) Flow pattern and classification method of gas-liquid two-phase flow, 2) Fundamentals of two-fluid model, 3) Modeling of dispersed multi-phase flow and numerical analysis, 4) Modeling of liquid atomization 5) Classification and role of fluid machinery 6) Generation of cavitation in pumps.

Structural Mechanics 2 credits
Elective Required
Professor Kanjuro Makihara
Associate Professor Keisuke Otsuka

This lecture gives a fundamental knowledge on the structural analysis and the structural design of mechanical structures. Main topics of this lecture are deformation and stress analyses of fuselage and wing structures subjected to bending, twisting and shear. (1) Fundamental of mechanical structure and material strength. (2) Vibration analysis for structures. (3) Applied load and stress analysis of mechanical structures. (4) Structural identification and structural health monitoring (5) Structural mechanics for aerospace engineering.

Aerospace Systems 2 credits Elective Required Professor Naofumi Ohnishi Adjunct Instructor Toshihiko Nakagawa Adjunct Instructor Soichiro Yada Lectures give the system concept of aircraft and rocket and discuss the basic design planning and the performance of these flight vehicles.	**Aerospace Propulsion** 2 credits Elective Required Professor Naofumi Ohnishi Associate Professor Masayuki Takahashi Lectures on principles of thrust generation of jet engine and rocket engine which propel vehicles in air and space are given, including structure of the engines and methods for improving their performance. Non-chemical propulsion schemes are also introduced, including physics of plasma.
Computational Fluid Dynamics 2 credits Elective Required Professor Soshi Kawai Associate Professor Yuichi Kuya This course provides the basic and advanced fundamentals and theories of modern computational fluid dynamics (CFD) methods for compressible flows. Also, we will provide lectures on the programming of numerical methods discussed in this course.	**Robotics for Space Exploration** 2 credits Elective Required Professor Kazuya Yoshida Robotics technology is useful for space development and exploration activities. In this course, the subject of Space Robotics is elaborated on the application to orbital servicing missions and lunar/planetary exploration. As for the "orbital robotics," the following topics are lectured: - Angular motion kinematics and attitude dynamics of a spacecraft, - Multi-body dynamics and control of a free-flying space robot, - Impact dynamics and post-impact control when a space robot captures a floating target. As for the "lunar/planetary robotics," the following topics are lectured: - Mission and system design for Lunar and asteroid exploration, - Mobility system design and analysis for locomotion on the lunar/planetary surface, - Sensing, planning, and navigation of a mobile robot. All lectures are given in English.
Spacecraft Engineering 2 credits Elective Required Professor Kazuya Yoshida Professor Kanjuro Makihara Professor Hiroki Nagai Associate Professor Toshinori Kuwahara In this course, the fundamental engineering issues are lectured in the following four parts for the design and development of spacecraft and space flight systems. (1) Orbital mechanics for various space missions (2) Attitude dynamics and control of spacecraft (3) Design of space structures, vibration analysis and control (4) Thermodynamics and thermal control of space systems All lectures are given in English.	**Mathematical Modeling and Computation** 2 credits Elective Required Professor Satoru Yamamoto This lecture introduces typical mathematical models on some physical and social problems observed in nature and in events which are basically formulated by a system of nonlinear partial-differential equations, and also teaches the numerical methods based on the finite-difference method for solving the mathematical models. Each student is subjected to make his own mathematical model and submits the computational result as the final report.
Applied Mathematical Fluid Dynamics 2 credits Elective Required Professor Yuji Hattori Associate Professor Makoto Hirota A number of ideas in applied mathematics, which include dynamical systems, differential geometry, Lie groups, and statistical mechanics, have been applied to fluid dynamics. Recent development in basic fluid dynamics is introduced and methods and ideas for attacking various problems in nonlinear dynamics are given. The lecture consists of three parts: (i) theory of hydrodynamics stability, (ii) statistical fluid dynamics, and (iii) topological fluid dynamics.	**High Performance Computing** 2 credits Elective Required Professor Hiroyuki Takizawa This course reviews high-performance computing systems from both aspects of hardware and software. The course talks about the importance of parallel processing, parallel system architectures, parallel algorithm design, parallel programming, and performance evaluation methodologies. The course also discusses the memory systems necessary for high-performance computing.

Fluid Design Informatics 2 credits

Elective Required

Professor Shigeru Obayashi

This lecture aims to construct the theories, learn the methodologies, and see the real-world examples of fluid engineering design, which is based on computational fluid dynamics (CFD) combined with information science. The outline of this lecture is organized as 1. design optimization, 2. gradient method, 3. evolutionary computation, 4. surrogate model, 5. physics-based optimization, 6. data mining, and 7. real-world applications.

Computer Architecture 2 credits

Elective Required

Professor Hiroaki Kobayashi

Associate Professor Masayuki Sato

The term “computer architecture” means the concept of designing computers and is also its philosophy. This course begins with the basic principles of computers, and then talks about instruction-level parallel processing, vector processing, parallel computing systems, and their control mechanisms. Supercomputing techniques such as vector systems and accelerators are also reviewed.

See the class web page for more details.

http://www.sc.isc.tohoku.ac.jp/class/architecture/

(Contact instructors to have an access ID).

Physical Fluctuomatics 2 credits

Elective Required

Professor Kazuyuki Tanaka

Applications to many fields in engineering like control, signal processing etc. and in information sciences are in mind through the lecture course for the basic knowledge of statistical machine learning theory as well as stochastic processes. Brief introduction will be given to methods for applications like statistical estimation etc., and to the relationship with statistical-mechanical informatics. We first lecture probability and statistics and their fundamental properties and explain the basic frameworks of Bayesian estimation and maximum likelihood estimation. Particularly, we show EM algorithm as one of familiar computational schemes to realize the maximum likelihood estimation. As one of linear statistical models, we introduce Gaussian graphical model and show the explicit procedure for Bayesian estimation and EM algorithm from observed data. We show some useful probabilistic models which are applicable to probabilistic information processing in the standpoint of Bayesian estimation. We mention that some of these models can be regarded as physical models in statistical mechanics. Fundamental structure of belief propagation methods is reviewed as powerful key algorithms to compute some important statistical quantities, for example, averages, variances and covariances. Particularly, we clarify the relationship between belief propagations and some approximate methods in statistical mechanics. As ones of application to probabilistic information processing based on Bayesian estimation and maximum likelihood estimations, we show probabilistic image processing and probabilistic reasoning. Moreover, we review also quantum-mechanical extensions of probabilistic information processing.

Environmental Administration 2 credits

Elective Required

Various teachers

The Graduate School of Environmental Studies has had a cooperation agreement with Miyagi Prefecture and Sendai City, respectively.
In this lecture, students learn about current status and issues related to environmental policies of Miyagi Prefecture and Sendai City (about climate change such as global warming, promotion of waste reduction and recycling including plastic recycling, and environment-related laws) to achieve environmental conservation and sustainable society and learn about environmental policies and environmental technologies.
In addition to lectures, this course can help students acquire practical knowledge and develop their ability to think about how to respond to environmental issues through exercise and facility tour.

Ethics of Engineering and Life 2 credits

Elective Required

Professor Tetsutaro Hattori

We will study wide range of ethical issues including "research ethics", which are important for researchers and engineers. Not only medical science but also engineering is closely related to “life”. Applying some engineering technologies to various fields such as medicine and food productions, we undoubtedly face the matter of life and death in humans and other creatures. The intrinsic influence of engineering is huge, which requires us to acquire sophisticated knowledge and learn the ethical norm. We will invite experts engaged in various fields to give lectures. We will also arrange group discussion and presentation.
*Note for foreign students: Lectures are given in Japanese. In slides and handouts, some lecturers give titles etc. both in Japanese and English, but others do not.

Special Lecture in Cooperation with JAXA **2 credits**

Elective Required

Department of Aerospace Engineering Academic Affairs Committee

Visiting teachers from JAXA (Japan Aerospace Exploration Agency) make special lecture on future space transportation system. Major topics are system and components of liquid rocket engines, hypersonic air-breathing engines including combined cycle engine, as well as hypersonic aerodynamics for both hypersonic flight and re-entry.

Internship Training 1 or 2 credits

Elective Required
All teachers

Practical training and research conducted at a company for around one week to one month in the first year of master's program. Through this training, students learn how to apply the basic research at university to a real industrial technology setting. Additionally, students gain on-site experience and understand the realities of planning, surveys and research, product development, manufacturing and product management, etc., in companies. It is desirable that all students take this training. One or two credits are given to them according to the content and the period of the training.

International Scientific Internship Training 1 or 2 credits

Elective Required
All teachers

When students have attended any lectures or practiced in a foreign academic organization or science program, one or two credits are given to them according to the content and the period.

Special Lecture on Aerospace Engineering A 1 or 2 credits

Elective Required
Various teachers

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Advanced Seminar on Aerospace Engineering A 1 or 2 credits

Elective Required
Various teachers

Addressing leading-edge academic research in the major area, this course comprises seminars on a subject which student have chosen themselves as well as training in and beyond the university. Integrating these advanced specialist knowledge helps to develop students' problem-posing ability.

Seminar on Aero Systems 2 credits

Elective Required
Professor Tomonaga Okabe
Professor Shigeru Obyashi
Professor Hiroki Nagai
Professor Soshi Kawai
Associate Professor Go Yamamoto
Associate Professor Yuichi Kuya
Associate Professor Yoshiaki Abe

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Space Systems 2 credits

Elective Required
Professor Naofumi Ohnishi
Professor Kazuya Yoshida
Professor Hideaki Kobayashi
Professor Kanjuro Makihara
Associate Professor Toshinori Kuwahara
Associate Professor Masayuki Takahashi
Associate Professor Keisuke Otsuka
Associate Professor Akihiro Hayakawa

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Master's Thesis Research in Aeronautics and Space Engineering 8 credits

Required
Various teachers

Students engage in experiments and seminars, including research presentations, discussion, and literature reviews. Students who have acquired credits from the Innovation Oriented Seminar on Mechanical Engineering program do not need to take this course.

授業科目表（MC）List of Courses

Department of Quantum Science and Energy Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	原子炉工学	隔年 Every second year	J		2		左記の専門基盤科目の内から３科目以上選択履修し，６単位以上修得すること. A student has to earn 6 or more credits from the Major basic subjects listed in the left column. ※補足参照 See note below.
	Nuclear Reactor Engineering	隔年 Every second year	E				
	核エネルギーシステム安全工学	隔年 Every second year	J		2		
	Safety Engineering of Nuclear Energy Systems	隔年 Every second year	E				
	粒子ビーム科学	隔年 Every second year	J		2		
	Science and Engineering of Particle Beam	隔年 Every second year	E				
	プラズマ物理･核融合学	隔年 Every second year	J		2		
	Plasma Physics and Fusion Energy	隔年 Every second year	E				
	固体物理	隔年 Every second year	J		2		
	Solid State Physics	隔年 Every second year	E				
	材料化学 Materials Chemistry	毎年 Every year	E		2		
専門科目 Major General Subjects	量子・統計力学 Quantum and Statistical Mechanics	隔年 Every second year	J		2		左記の専門科目の内から少なくても 2 科目以上選択履修し 4 単位以上を修得すること。 A student has to earn 4 or more credits from the major general subjects listed in the left column.
	エネルギーフロー環境工学	隔年 Every second year	J		2		
	Environmental Perspective on the Energy Flow	隔年 Every second year	E				
	中性子デバイス工学	隔年 Every second year	J		2		
	Engineering for Neutron Devices	隔年 Every second year	E				
	保全工学	隔年 Every second year	J		2		
	Basics for Plant Life Management	隔年 Every second year	E				
	核エネルギーシステム材料学	隔年 Every second year	J		2		
	Materials for Nuclear Energy Systems	隔年 Every second year	E				
	実験原子力システム工学 Experimental Nuclear System Engineering	毎年 Every year	J		2		
	先進原子力総合実習 Advanced Practical Nuclear Engineering	毎年 Every year	J		1		

	原子力基盤コンクリート工学 Concrete for Nuclear Power Plants	毎年 Every year	J		2		特別講義 A, 特別研修 A で修得した単位は 2 単位まで本要件に含めることができる．なお，ダブルディグリープログラム，共同教育プログラムの学生に限り，特別講義 A の単位を 8 単位まで本要件に含めることができる。 A total of 2 credits at most, obtained from Advanced seminar A and Special lecture A, is included in the MC completion requirement. As an exception, a total of 8 credits obtained from Special lecture A is included in the requirement, when a student is enrolled in our double-degree program or joint educational program.
	総合耐震工学 General Earthquake Engineering	毎年 Every year	J		2		
	原子力安全の論理と規制Ⅰ Nuclear Safety Theory and Regulation I	毎年 Every year	J		2		
	原子力安全の論理と規制Ⅱ Nuclear Safety Theory and RegulationⅡ	毎年 Every year	J		2		
	原子炉廃止措置工学 Engineering for Nuclear Reactor Decommissioning	毎年 Every year	J		2		
	物理フラクチュオマティクス論 Physical Fluctuomatics	毎年 Every year	J		2		
	環境行政論 Environmental Administration	毎年 Every year	J		2		
	工学と生命の倫理 Ethics of Engineering and Life	毎年 Every year	JE		2		
	鉄筋コンクリート構造 Reinforced Concrete Structures	毎年 Every year	J		2		
	インターンシップ研修 Internship Training				1~2		
	国際学術インターンシップ研修 International Scientific Internship Training				1~2		
	量子エネルギー工学特別講義Ａ Special Lecture on Quantum Energy Engineering A				1~2		
	量子エネルギー工学特別研修Ａ Advanced Seminar on Quantum Energy Engineering A				1~2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	先進原子核工学セミナー Seminar on Advanced Nuclear Energy Engineering	毎年 Every year	JE		2		左記のセミナーのうちから，指導教員の所属するセミナー 2 単位を修得すること．

	原子核システム安全工学セミナー Seminar on Safety Engineering of Nuclear Energy Systems	毎年 Every year	JE		2		Students must earn 2 credits from one of their supervisor's seminars listed in the left column.
	エネルギー物理工学セミナー Seminar on Energy Physics Engineering	毎年 Every year	JE		2		
	粒子ビーム工学セミナー Seminar on Particle-Beam Engineering	毎年 Every year	JE		2		
	エネルギー材料工学セミナー Seminar on Energy Materials	毎年 Every year	JE		2		
	エネルギー化学工学セミナー Seminar on Energy Chemical Engineering	毎年 Every year	JE		2		
	量子物性工学セミナー Seminar on Quantum Theoretic Materials Engineering	毎年 Every year	JE		2		
	加速器放射線工学セミナー Seminar on Accelerator Radiation Science and Engineering	毎年 Every year	JE		2		
	量子エネルギー工学修士研修 Master's Thesis Research in Quantum Science and Energy Engineering			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

"Schedule" is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

※補足）なお、2 科目（4 単位）まで、「応用科学専攻」「化学工学専攻」「バイオ工学専攻」の専門基盤科目の選択履修を認める場合があるので、希望者は予め専攻長または大学院教務委員に届け出ること。

Students may be allowed to take up to two elective courses (4 credits) in the Major basic subjects of the "Department of Applied Chemistry" "Department of Chemical Engineering" "Department of Biomolecular Engineering"

Those who wish to apply must notify the department chair or a member of the Graduate School Academic Affairs Committee in advance.

修了要件単位数

Credits requirement for MC completion

専門基盤科目　Major Basic Subjects	6 credits or more
専門科目　Major General Subjects （Excluding the subjects below）	4 credits or more
専門科目　Major General Subjects ・ Internship Training ・ International Scientific Internship Training ・ Special Lecture　A ・ Advanced Seminar A	
関連科目 Related Subjects of Other Majors	
セミナー　Seminar	2 credits
修士研修　Master's Thesis Research	8 credits
合計 Total	30 credits or more

Nuclear Reactor Engineering 2 credits

Elective Required

Professor Hidetoshi Hashizume

Associate Professor Shinji Ebara

The objective of this class is to understand the basics and applications of thermal fluids and electromagnetic phenomena in nuclear reactors and to respond to national examination together with system modeling capability from the viewpoint of integrated engineering. The main contents are;

1. Heat transfer related to fuel rods
2. Basic matter about boiling and application
3. Pipe flow and natural convection
4. Structural analysis
5. Thermal hydraulics in a nuclear reactor plant
6. Modeling of turbulence flow

Safety Engineering of Nuclear Energy Systems 2 credits

Elective Required

Professor Makoto Takahashi

Associate Professor Daisuke Karikawa

The design of huge complex system such as nuclear power plant is presented in this lecture with the emphasis on the design for safety, redundant system, defense on depth. The basics of reliability engineering, probabilistic safety assessment and human reliability analysis are also lectured.

In the latter half of the lecture, students perform simulation based practical training using PC-based nuclear power plant simulator in order to understand the basic plant behavior and the possible scenarios of severe accidents simulating what happened in the Fukushima Daiichi nuclear power plant accident.

Science and Engineering of Particle Beams 2 credits

Elective Required

Professor Shigeo Matsuyama

Professor Atsuki Terakawa

Professor Manabu Tashiro

Associate Professor Yohei Kikuchi

Associate Professor Seong-Yun Kim

Associate Professor Keitaro Hitomi

Associate Professor Wataru Kada

Particle beams are used in a wide range of fields, from science and engineering to medicine. In addition to learning basic knowledge such as the basic characteristics of particle beams, the interaction between particles and materials, and the interaction between particles and cells, as well as the state-of-the-art application technology, the course will include particle beam acceleration technology, fundamental devices in applications, and the systematic and/or beam control techniques.

This lecture covers the knowledge of accelerator-related fields of the Radiation Protection Supervisor Supervisor Examination.

Plasma Physics and Fusion Energy 2 credits

Elective Required

Professor Kenji Tobita

Associate Professor Tetsutaro Oishi

Senior Assistant Professor Hiroyuki Takahashi

The objective of this class is to learn about the foundational principles of plasma and the engineering aspects of fusion energy. Starting from the fundamentals of plasma behaviors and particle orbits in electromagnetic fields, the physics part will be expanded to plasma confinement and transport theory, magnet-hydrodynamic equilibrium of plasma, plasma heating and current drive. Based on the physics, the course will address the concept of fusion power systems and fusion-relevant technologies to realize fusion energy, covering superconducting magnet, divertor, plasma heating systems. In the last part of the course, safety, environmental and socioeconomic aspects of fusion energy will be presented.

Solid State Physics 2 credits

Elective Required

Professor Dai Aoki

Associate Professor Keitaro Hitomi

Associate Professor Atsushi Miyake

This course targets students from mechanical engineering, system engineering and a wide range of other specialized areas. Using Introduction to Solid State Physics (Charles Kittel, Eighth Edition) as the main text, it focuses on the fundamentals of material science. Following the chapter order in this textbook, each class will cover the content associated with that chapter. The course aims to provide students from a wide range of areas with an understanding of the basics concept of solid-state physics and a broad perspective on the behavior of materials in engineering systems.

Materials Chemistry 2 credits

Elective Required

Professor Yutaka Watanabe

Professor Koji Amezawa

Professor Eiji Akiyama

Associate Professor Yoichi Takeda

Most metals in the earth's atmosphere inevitably change into more thermodynamically stable compounds such as oxides or sulfides. To understand this principle more precisely, students will learn chemical and electro-chemical equilibrium theory, and kinetics theory in relation to corrosion and oxidation of metals. Practical examples will be used to explain the phenomena and theories of wet corrosion and high-temperature oxidation, deepening students' understanding of the chemical and electro-chemical reactions related to macro phenomena of corrosion and oxidation. This course will be offered in English with a lecture and practice style, using English-language materials. A detailed outline of the course will be presented during the first class.

Quantum and Statistical Mechanics 2 credits

Elective Required

Professor Yasuyoshi Nagai

Associate Professor Koji Inoue

Associate Professor Takeshi Toyama

Associate Professor Kenta Yoshida

Associate Professor Keitaro Hitomi

Fundamentals of quantum mechanics and statistical mechanics will be lectured. The main contents are:

1. General theory of quantum mechanics
2. Potential problems
3. Approximation methods
4. Identical particles and spin
5. Fermi-Dirac and Bose-Einstein statistics
6. Quantization of electromagnetic field
7. Others

Environmental Perspective on the Energy Flow 2 credits

Elective Required

Professor Yuichi Niibori

Associate Professor Seong-Yun Kim

Associate Professor Taiji Chida

Visiting Professor Masayuki Watanabe

The objective of this course is to quantitatively understand the relations of primary energies and global environment based on "Energy Flow", which is a national energy balance. Besides, the utility of mass or heat balance is learned in order to find out what the essential issue is through some topics including fossil fuel, global warming, acid rain and radioactive wastes of nuclear energy. Furthermore, the advanced analytical chemistry regarding natural environment and nuclear energy, the reprocessing of spent fuel, the safety assessment of geological disposal system regarding radioactive wastes, and so on are discussed.

Engineering for Neutron Devices 2 credits

Elective Required

Professor Shigeo Matsuyama

Associate Professor Shinji Ebara

Neutron Device Engineering is the lecture on the behavior of neutron in the system and device such as fission and fusion reactor from the viewpoint of microscopic to macroscopic. The main topics of the lecture are “Transport of neutron in a medium” and “Dynamics and control of neutron in an energy system and device like nuclear reactor”.

This lecture is compulsory for the student who pursues the license for chief engineer of reactor. Besides, it is desired that student takes the lecture of “Introduction to Neutron Transport” in undergraduate course.

Basics for Plant Life Management 2 credits

Elective Required

Professor Yutaka Watanabe

Professor Tetsuya Uchimoto

Professor Noritaka Yusa

Associate Professor Hiroshi Abe

This course covers the fundamentals and theories of maintenance of plant equipment, mainly nuclear power plants. It includes the basic concept of maintenance, aging phenomena of structural materials, inspection techniques, integrity evaluation, and deterioration countermeasure techniques. The main aging phenomena are pipe thinning, stress corrosion cracking, embrittlement, fatigue, etc. Phenomenology, examples, mechanisms and control techniques are lectured for each deterioration mode. Special lectures and discussions by experts from industry and government will be provided as necessary.

Materials for Nuclear Energy Systems 2 credits

Elective Required

Professor Ryuta Kasada

Associate Professor Sosuke Kondo

The purpose of this lecture is to learn the relationship between nuclear energy systems, such as fission reactors and fusion reactors, and the various materials used in the nuclear energy systems.

In order to understand the role of materials in the nuclear energy systems, students learn the concept of stability of energy systems in a broad view. Students will participate in workshop-style group exercises to recognize and explain the stability of energy systems and learn system dynamics methods that can be applied to the investigation and analysis of energy system stability.

Irradiation damage, which is a phenomenon unique to materials used in nuclear energy systems, and the resulting irradiation effects will be introduced. The overall concept of structural integrity of nuclear energy systems that use materials with irradiation effects will be shown with focusing on specific examples in reactor pressure vessel steels. Students will learn the basics of environmental resistance and accident behavior of materials used in nuclear energy systems, as well as the status of accident-resistant fuels that have been developed in recent years.

Based on the previous engineering knowledge, students are expected to learn about the concept of the lifetime of nuclear energy systems from not only an engineering perspective but also a social perspective. In addition, students will be able to recognize their own viewpoints on the relationship between nuclear energy systems and society and discuss them with others through exercises.

Experimental Nuclear System Engineering 2 credits

Elective Required

Professor Shigeo Matsuyama

Student must participate in one practical experiment program of following #1 or #2. The recognition of credit on Experimental Nuclear System Engineering is evaluated on the basis of the contents of report in practical experiment program.

#1 Nuclear reactor experiment and Operation control work of reactor by the use of critical assembly experiment facility at Kyoto University Reactor Research Institute

#2 Experiment of actinide element and material for nuclear application at International Research Center for Nuclear Material Science, Institute for Materials Research, Tohoku University

The credit of the lecture can be approved if student participates in an experiment or practical training on nuclear engineering system held at university or research institute in the country or overseas such as Japan Atomic Energy Agency. In this case, student must submit a certification of the experiment or training issued by concerned institute and a report on the experiment or training. The recognition of credit is evaluated on the basis of the report.

Advanced Practical Nuclear Engineering 1 credits

Elective Required

Professors of Department

Quantum science and energy engineering, which is indispensable for the deep understanding of nuclear energy and particle beam, is comprehensive engineering. Graduate students of the Department are required to have wide and deep understandings on the whole quantum energy engineering in addition to their specialized field.
This course aims to deepen understanding of the whole of quantum energy engineering and to obtain practical knowledge on these subjects by the classroom lectures and practical training on important subjects on some key elements of quantum energy engineering such as plasma measurement, material damages, accelerator, fluid dynamics, etc.

Concrete for Nuclear Power Plants 2 credits

Elective Required

Professor Makoto Hisada

Associate Professor Hiroshi Minagawa

Associate Professor Shintaro Miyamoto

In this class, students learn the general properties of concrete, required quality of various materials for concrete production and its testing method, production method of concrete, construction method to build concrete structures. This class provides the explanations of the relationship between the properties of the concrete and the properties of the materials used as well as the production and construction method of concrete, to help students understand the fabrication of concrete suitable for the design conditions, for materials selection, mix proportion design, production, construction etc.

General Earthquake Engineering 2 credits

Elective Required

Professor Shigeki Unjoh

This course provides students with the basic theories on the dynamic behavior of infrastructures subjected to earthquake ground motions and the seismic design methods. The purpose of this course is to help students understand the process of seismic design of structures, including mathematical modeling, earthquake response analysis methods and the performance evaluation of structures as well as the basic knowledge for the seismic design.

Nuclear Safety Theory and Regulation I 2 credits

Elective Required

Professor Hidetoshi Hashizume

A specially appointed professor Juichi Endo

A specially appointed professor Seiji Abe

A specially appointed professor Eiji Hiraoka

The basic concepts to achieve nuclear safety, the role of nuclear regulation, safety issues identified by the Fukushima accident, etc. are lectured. Especially, what is the basis of important regulatory decision-makings and real experiences during the Fukushima-Daiichi accident are introduced. Outside experts in various fields may be invited as lecturers to discuss regulatory issues and Fukushima accident issues to consider the relationship between the nuclear regulation and the society.

Nuclear Safety Theory and Regulation II 2 credits

Elective Required

Professor Hidetoshi Hashizume

A specially appointed professor Juichi Endo

A specially appointed professor Seiji Abe

A specially appointed professor Eiji Hiraoka

Lectures will be given on basic concepts for ensuring nuclear safety, the role of regulatory authorities, and issues related to the Fukushima Daiichi accident.
The lecture will focus on problems behind the accident and actual experiences at the time of the accident. Lecturers with different careers will be invited to discuss various issues related to safety regulations and the Fukushima accident from a variety of perspectives, and to create opportunities to think about the relationship between safety regulations and society.

Engineering for Nuclear Decommissioning 2 credits

Elective Required

Professor Yutaka Watanabe

Professor Yuichi Niibori

Professor Makoto Takahashi

Specially Appointed Professor Koji Dozaki

Visiting Professor Masahiro Yamamoto

This lecture mainly focuses on the Fukushima Dai-ichi Nuclear Power Station and provides the necessary theories for the safe decommissioning of nuclear reactors after a severe accident. This lecture focuses on the current status of Fukushima Daiichi NPS, lessons learned from past core disruptive accidents, current status and issues of decommissioning research, various efforts for technological development issues, as well as the current status of academic infrastructure such as the concept of ensuring long-term integrity of steel and RC structures during decommissioning, basics of fuel debris, treatment and disposal, and risk communication.

Physical Fluctuomatics 2 credits

Elective Required

Professor Kazuyuki Tanaka

Applications to many fields in engineering like control, signal processing etc. and in information sciences are in mind through the lecture course for the basic knowledge of statistical machine learning theory as well as stochastic processes. Brief introduction will be given to methods for applications like statistical estimation etc., and to the relationship with statistical-mechanical informatics. We first lecture probability and statistics and their fundamental properties and explain the basic frameworks of Bayesian estimation and maximum likelihood estimation. Particularly, we show EM algorithm as one of familiar computational schemes to realize the maximum likelihood estimation. As one of linear statistical models, we introduce Gaussian graphical model and show the explicit procedure for Bayesian estimation and EM algorithm from observed data. We show some useful probabilistic models which are applicable to probabilistic information processing in the standpoint of Bayesian estimation. We mention that some of these models can be regarded as physical models in statistical mechanics. Fundamental structure of belief propagation methods is reviewed as powerful key algorithms to compute some important statistical quantities, for example, averages, variances and covariances. Particularly, we clarify the relationship between belief propagations and some approximate methods in statistical mechanics. As ones of application to probabilistic information processing based on Bayesian estimation and maximum likelihood estimations, we show probabilistic image processing and probabilistic reasoning. Moreover, we review also quantum-mechanical extensions of probabilistic information processing.

Environmental Administration 2 credits

Elective Required

Various teachers

The Graduate School of Environmental Studies has had a cooperation agreement with Miyagi Prefecture and Sendai City, respectively.
In this lecture, students learn about current status and issues related to environmental policies of Miyagi Prefecture and Sendai City (about climate change such as global warming, promotion of waste reduction and recycling including plastic recycling, and environment-related laws) to achieve environmental conservation and sustainable society and learn about environmental policies and environmental technologies.
In addition to lectures, this course can help students acquire practical knowledge and develop their ability to think about how to respond to environmental issues through exercise and facility tour.

Ethics of Engineering and Life 2 credits

Elective Required

Professor Tetsutaro Hattori

We will study wide range of ethical issues including "research ethics", which are important for researchers and engineers. Not only medical science but also engineering is closely related to "life". Applying some engineering technologies to various fields such as medicine and food productions, we undoubtedly face the matter of life and death in humans and other creatures. The intrinsic influence of engineering is huge, which requires us to acquire sophisticated knowledge and learn the ethical norm. We will invite experts engaged in various fields to give lectures. We will also arrange group discussion and presentation.
*Note for foreign students: Lectures are given in Japanese. In slides and handouts, some lecturers give titles etc. both in Japanese and English, but others do not.

Reinforced Concrete Structures 2 credits

Elective Required

Professor Masaki Maeda

Reinforced concrete structures are an extremely rational structure that combines concrete, which is strong in compression, and reinforcing bars, which are strong in tension, and are widely used in everything from low-rise buildings to super-high-rise buildings. In the lecture, we will explain the properties of materials, the principles and characteristics of structures, the mechanical properties of the main structural members such as beams, columns, and shear walls, and discuss the performance required for structures and their verification methods. Learn the basic concepts of structural design for reinforced concrete buildings by explaining past earthquake damage and earthquake-resistant design standards.

Internship Training 1 or 2 credits

Elective Required

All Professors

Practical training and research conducted at a company for around one week to one month in the first year of master's program. Through this training, students learn how to apply the basic research at university to a real industrial technology setting. Additionally, students gain on-site experience and understand the realities of planning, surveys and research, product development, manufacturing, and product management, etc., in companies. It is desirable that all students take this training. One or two credits are given to them according to the content and the period of the training.

International Scientific Internship Training 1 or 2 credits

Elective Required

All Professors

When students have attended any lectures or practiced in a foreign academic organization or science program, one or two credits are given to them according to the content and the period.

Special Lecture on Quantum Energy Engineering A 1 or 2 credits
Elective Required
Professors of Department

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Advanced Seminar on Quantum Energy Engineering A 1 or 2 credits
Elective Required
Professors of Department

Addressing leading-edge academic research in the major area, this course comprises seminars on a subject which student have chosen themselves as well as training in and beyond the university. Integrating these advanced specialist knowledge helps to develop students' problem-posing ability.

Seminar on Advanced Nuclear Energy Engineering 2 credits
Elective Required
Professors of Department

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Safety Engineering of Nuclear Energy Systems 2 credits
Elective Required
Professor Yutaka Watanabe
Professor Yuichi Niibori
Professor Makoto Takahashi
Professor Noritaka Yusa
Associate Professor Daisuke Karikawa
Associate Professor Hiroshi Abe
Associate Professor Taiji Chida

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Energy Physics Engineering 2 credits
Elective Required
Professor Hidetoshi Hashizume
Professor Kenji Tobita
Associate Professor Satoshi Ito
Associate Professor Shinji Ebara
Associate Professor Tetsutaro Oishi

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Particle-Beam Engineering 2 credits
Elective Required
Professor Shigeo Matsuyama
Associate Professor Youhei Kikuchi
Associate Professor Seong-Yun Kim
Associate Professor Keitaro Hitomi
Associate Professor Miho Shidahara
Associate Professor Wataru Kada

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Energy Materials 2 credits
Elective Required
Professor Yasuyoshi Nagai
Professor Ryuta Kasada
Associate Professor Koji Inoue
Associate Professor Takeshi Toyama
Associate Professor Kenta Yoshida
Associate Professor Sosuke Kondo

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Energy Chemical Engineering 2 credits
Elective Required
Professor Akira Kirishima
Lecturer Daisuke Akiyama

By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.

Seminar on Quantum Theoretic Material Engineering 2 credits Elective Required Professor Eiji Akiyama Professor Dai Aoki Associate Professor Motomichi Koyama Associate Professor Atsushi Miyake By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.	**Seminar on Accelerator Radiation Science and Engineering** 2 credits Elective Required Professor Hiroshi Watabe Professor Atsuki Terakawa By introducing and discussing key research papers in relation to their master's thesis, as well as the background to and interim results of their own research. Through this seminar, students will identify research trends in their particular area and the position of their own research.
Master's Thesis Research in Quantum Science and Energy Engineering 8 credits Required Professors of Department Students fulfill master's thesis research through experiments, numerical simulations, analysis, research presentations, discussions, literature reviews in any research group specializing in advanced nuclear engineering, nuclear system safety engineering, energy physics, particle beam engineering, energy material engineering, energy chemical engineering, quantum physics engineering, or accelerator and radiological engineering.	

授業科目表（MC）Opening of a course class subject list

Department of Electrical Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	Electric Power Systems Engineering	Every year	JE		2		A student has to earn 4 or more credits from the major basic subjects listed in the left column.
	Power Electronics	Every year	JE		2		
	System Control Theory	Every year	JE		2		
	Foundations of Algorithms	Every second year	JE		2		
	Signal Processing for Communications	Every year	JE		2		A student has to earn 6 or more credits from the major basic subjects in the left column including the above designated subjects.
	Wave Transmission Theory	Every year	JE		2		
	Communications Devices	Every year	JE		2		
	Foundations of Computer Software	Every year	JE		2		
	Theory of Differential Equations	Every year	J		2		
	Thermodynamics and Statistical Mechanics	Every year	JE		2		
	Solid State Physics	Every year	JE		2		
	Introduction to Semiconductor Device Physics and Technology	Every year	J		2		
	Hardware Fundamentals	Every year	JE		2		
専門科目 Major General Subjects	Plasma Energy and Engineering	Every second year	JE		2		A student has to earn 10 or more credits from the major general subjects listed in the left column or the related subjects offered by other departments.
	Micro Energy Engineering	Every second year	JE		2		
	Ubiquitous Electrical Energy Engineering	Every second year	JE		2		
	Superconducting Energy Engineering	Every second year	JE		2		
	Green Device Engineering	Every second year	JE		2		
	Magnetic Devices	Every second year	JE		2		
	Power System Economics	Every second year	JE		2		
	Microscopic Processing of Surfaces	Every year	J		2		
	Fundamentals on Ultrasonic Engineering	Every second year	JE		2		
	Secure Information Communication Systems	Every second year	JE		2		
	Ethics of Engineering and Life	Every year	JE		2		
	Intellectual Property Strategy	Every year	J		2		
	Research and Development of Information Electronics System	Every year	J		2		
	RF Measurement Engineering	Every year	JE		2		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Advanced Seminar				1~2		
	Special Lecture on Electrical Engineering A	Every year	J		1~2		
	Writing and Presentation for English Technical Paper A	Every year	E		2		

関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Seminar on Energy Device Engineering				6		A student has to earn 6 credits from one of the seminars listed in the left column.
	Seminar on Electrical Energy System Engineering				6		
	Seminar on Intelligent Energy System Engineering				6		
	Master's Thesis Research in Electrical Engineering			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。
Students must acquire 30 or more credits from the subjects above.
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

Electric Power Systems Engineering 2 credits
Elective Required
Professor Saito

Students will learn the following basic technologies which are the most important parts for modern electric power systems to achieve stable and reliable supply and transmission of electric energy under the interconnection of large amounts of intermittent renewable energy such as photovoltaic generation and wind power generation.
(1) Frequency and active power control
(2) Voltage and reactive power control
(3) Power system security and power flow analysis
(4) Power system stability and its analysis methods

Power Electronics 2 credits
Elective Required
Professor Endoh

Power electronics is a technical field that converts and controls electric power using the switching action of power semiconductor devices. The lecture reviews the history of power electronics, the operating principles and trends of power semiconductor devices, and the theory of operation of power conversion circuits. In addition, various power electronics devices such as motor drive technology to control industrial machinery will be explained.

System Control Theory 2 credits
Elective Required
Professor Ishiguro, Professor Homma, Professor Sugita

To control large scale and multi variable dynamical systems such as robots, automobiles, and electrical plants, lectures on system control theory will be given on the basis of the state space control method. Moreover, post modern control theories based on soft computing and bio-inspired methods will be explained.

Foundations of Algorithms 2 credits
Elective Required
Professor Zhou, Associate Professor Suzuki

Algorithms now play a very important role for the reliability and efficiency in several social systems. This course focuses on design and analysis of algorithms from the viewpoint of theoretical computer science. We deal with parallel algorithms, approximation algorithms, randomized algorithms etc. We also show some applications of algorithm theory to practical problems.

Signal Processing for Communications 2 credits
Elective Required
Professor Ito, Professor Sakamoto, Associate Professor Nose

The lecture will cover the basic theory of communication signal processing (orthogonal transforms from Fourier transform to discrete cosine transform, z-transform and digital filter, wavelet transform, system identification and adaptive filtering), which has progressed rapidly in recent years with the development of computers. The purpose of this course is to map these mathematical foundations to engineering applications and to deepen understanding of communication signal processing techniques through exercises.

Wave Transmission Theory 2 credits
Elective Required
Professor Chen, Professor Yoshizawa

This lecture presents the fundamental theories of radiation, propagation, diffraction, and scattering of radio waves, light waves, sound waves, and ultrasonic waves from viewpoint of wave engineering. Various applications of these wave phenomena are lectured as well.

Communications Devices 2 credits
Elective Required

This class forcus on study about communication devices used in today's wireless and wired communications. In the first half, the operation mechanisms of communication devices that have been softwarelaired will be lectured, and in the second half, optical fiber used for fiber-optic communication and semiconductor laser, optical amplifier, optical modulator, optical switch, optical multiplexer/demultiplexer and receiver will be lectured to understand the mechanisms and operating principles of optical devices.

Foundations of Computer Software 2 credits
Elective Required
Professor Sumii, Associate Professor Matsuda

Reliability of software is crucial in modern society where social infrastructures are controlled by computers. We lecture methods of understanding software with mathematical logic and discussing/verifying its behavior with rigor. Specifically, we cover computation models and their formal semantics that form the basis of software description, as well as software specification, verification, and type systems based on those models and semantics.

Theory of Differential Equations 2 credits

Elective Required

Professor Tanaka

1. The differential equations play a very important role in physics and engineering. In this lecture, students study some ordinary differential equations of a complex variable, some partial differential equations and the method of Green's function on the basis of the contents studied in the undergraduate course for the differential equations.
2. The main topics are as follows : integral representations of solutions for second order ordinary differential equations of a complex variable, partial differential equations, heat equations, Laplace's equation, Poisson's equation, the eigenvalue problem of partial differential equations and related Green's function method and so on.
3. Students study those topics by keeping application to engineering in mind, along with their fundamental concepts.

Thermodynamics and Statistical Mechanics 2 credits

Elective Required

Professor Shirai

The aim of this class is to understand the basis of statistical mechanics, which gives methods to derive macroscopic properties of a system from the microscopic states of an ensemble of constituent particles. First, students will acquire the methods of statistical mechanics describing equilibrium states, and then learn the basis of statistical mechanics for understanding non-equilibrium phenomena, e.g. electric transport. Finally, students will understand the relationship between the response to an external field and the fluctuation of the relevant system, e.g. various physical properties of electronic and magnetic materials.

Solid State Physics 2 credits

Elective Required

Associate Professor Fukidome

Solid-state physics (SSP) in the 20th century was dedicated to analyze structures and functions of natural substances. Now in this 21st century, the goal of SSP has shifted to designing and synthesizing new materials, from the atomic level, to try to demonstrate required functions. Designing and synthesizing things to realize desired functionality is nothing but engineering; SSP-based engineering should be the mainstream in SSP in this century. Being focused on engineering, this class will proceed in a from-engineering-to-physics manner, not from-physics-to-applications manner as they do in the faculty of science. Another reason to take this order is to save time. Engineers usually do not have enough time to master all the essentials in SSP before going to specific topics. What is important here is to have right images on basic concepts in SSP to use them as a tool to understand emerging technologies and elaborate them. Conceptual understanding comes first before mathematical rigor. The class will focus on several topics specially selected in terms of importance in today's electronics and electrical engineering, but is open to those that form the physical basis of the research theme of the students. Students are required to be strongly motivated in attending the class.

Introduction to Semiconductor Device Physics and Technology 2 credits

Elective Required

Professor Kuroda, Associate Professor Sakuraba

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Hardware Fundamentals 2 credits

Elective Required

Professor Hanyu, Professor Hariyama,

Associate Professor Waidyasooriya

Students will learn the basics of integrated circuit technologies, processor architecture, and intelligent integrated systems that combine intelligent-processing techniques with integrated circuits.

Classes will focus in particular on (1) the outline and importance of intelligent integrated systems, (2) high-level synthesis techniques for high performance and low-power VLSI processors, (3) high-performance and low-lower CMOS integrated-circuit design techniques, (4) design method using reconfigurable processors such as FPGAs, (5) circuit-design techniques of high-performance VLSI whose performance would be degraded due to wiring complexity, (6) implementation techniques concerning power-supply lines and clock distribution, and (7) systematic design techniques of System-on-a-Chips.

Plasma Energy and Engineering 2 credits

Elective Required

Associate Professor Takahashi

In order to understand the electromagnetic fluid phenomena observed in various parameter regions in space plasmas and fusion plasmas, the lecture aims to deepen the understanding of plasma phenomena as an electromagnetic fluid and to obtain a comprehensive understanding of plasma energy from basics to applications, such as the principle of electromagnetic fluid acceleration and application to space propulsion technology, and confinement of fusion plasma, heating of ultra-high temperature plasma and application to fusion energy power reactors.

Micro Energy Engineering 2 credits Elective Required Professor Endo, Lecturer Aoki With the rapid development of mobile electronics, Small medical welfare devices, and so on, the micro energy source is gathering much attention from both fundamental and industrial points of view. In this class, students will be taught generation, transmission, control, storage, and use of micro energy related to electrical energy systematically, and also learn about the current technology trend of micro energy.	**Ubiquitous Electrical Energy Engineering** 2 credits Elective Required Professor Yabukami, Associate Professor Kuwahata Based on Maxwell's equations, we will lecture on the properties of electromagnetic fields and electromagnetic waves, which are the basis of ubiquitous energy utilization. In addition to discussing the operating principles and design guidelines for contactless power transmission systems, which are the foundation of ubiquitous energy applications, we will also take up applications to mobile systems and home appliances, and outline and operate principles of each, as well as ways to improve efficiency.
Superconducting Energy Engineering 2 credits Elective Required Professor Tsuda, Associate Professor Nagasaki Superconductors have inherent properties such as zero electrical resistance and perfect diamagnetism, and have various features such as enabling high power transport and storage with low loss. Therefore, superconductivity technology is expected to be one of the fundamental technologies indispensable for highly efficient utilization of electric energy in the future. However, in order to apply superconductivity technology to electric energy equipment and systems, it is necessary to learn a wide range of topics from basic properties of superconductors to superconducting equipment and system technology using superconducting wires and coils. Therefore, in this lecture, the fundamentals and applications of superconducting energy engineering will be lectured based on recent application examples of superconducting energy devices and systems and the latest research and development trends in superconducting application technology.	**Green Device Engineering** 2 credits Elective Required Professor Endoh Energy conservation is becoming increasingly important in a wide range of fields, including IT equipment, digital home appliances, white goods , power conditioners used in solar power generation systems, electric vehicles, trains, and power transmission systems. Green devices, such as power semiconductor devices and energy conversion devices, are becoming increasingly important to achieve this energy conservation. The objective of this lecture is to master the fundamentals of green devices and their applications. The lecture will provide an overview of green devices and the operation of each device. The lecture will also cover the fundamentals of device design, manufacturing, and integration technology of green devices, which are fundamental technologies for a low-carbon society. The application of green devices will also be discussed.
Magnetic Devices 2 credits Elective Required Professor Ishiyama We will lecture on magnetism, magnetic anisotropy, magnetic domain structure, high-frequency characteristics, nonlinear characteristics of thin films and bulk magnetic materials and their applications to measurement, control, storage, and energy conversion.	**Power System Economics** 2 credits Elective Required Professor Saito Students will learn basic concepts such as the consumer-producer model and market, which are necessary to understand the supply and demand mechanism and supply system of electricity and energy deeply related to society and economics from an economic perspective. Students will also learn about the characteristics of electricity markets and the relationship among the markets, electricity system security and transmission networks, as well as the latest trends in electricity system planning and operation.
Microscopic Processing of Surfaces 2 credits Elective Required Professor Kuroda, Professor Higurashi Students will be taught the advanced topics on microscopic processing for manufacturing LSI, magnetic memories and displays. This course covers basics and deep knowledge on the topics as well as, the current issues and their possible solutions. Through the classes this course is targeted to provide students with the problem solving abilities. Classes will focus on the ultra-clean and high-density process technologies, nanoscale material design and measurements of solid-state surfaces, especially fabrications and measurements of highly scaled-down and three-dimensional structures.	**Fundamentals on Ultrasonic Engineering** 2 credits Elective Required Professor Yoshizawa The objective of this course is to provide students with an understanding of the physical fundamentals of ultrasonic waves, which are widely applied in nondestructive testing, medical diagnosis and treatment, and to enable them to use basic theories such as the wave equation. The course includes lectures on the wave equation of ultrasonic waves propagating in an elastic medium, directivity of ultrasonic wave transmitter/receiver, and methods of analyzing measured ultrasonic signals. Through exercises on them, students will acquire a deeper understanding and become familiar with the handling of basic theories.

Secure Information Communication Systems 2 credits Elective Required Professor Homma The objective is to learn the basics for building an information communication system securely. In this lecture, we first study the basics of modern cryptography, the fundamentals to construct information security. In particular, we learn about the algorithms and implementation of symmetric key and public key cryptography. We then learn about the outline of physical attacks applied to the implementation and countermeasures against them. On that basis, we learn related technologies such as next-generation cryptography, secure computing technique, hardware authentication, electromagnetic information security, and IoT security.	**Ethics of Engineering and Life** 2 credits Elective Required Specially Appointed Assistant Professor Han Luo The purpose of this lecture is to provide an opportunity for students as engineers to think about the future from a broad perspective. Industrial development since the Industrial Revolution has been accelerating day by day, and our daily lives are also undergoing rapid changes. However, if we are blinded by such changes, we may lose sight of the goal that science and technology should originally aim at: the promotion of people's happiness. In this course, we will review the interface between engineering and society in relation to life. This is because modern engineering has reached the realm of direct and indirect contact with "life". When engineering is involved in fields such as medicine and food, it is confronted with situations that directly affect the life and death of humans and other living organisms. There is no small possibility that environmental problems resulting from the massive consumption of materials and energy will threaten the survival of our living organisms. To broadly consider these issues, lecturers from various fields such as engineering, medicine, and welfare will be invited to give lectures and hold discussions. In addition, there will be opportunities for group presentations on issues related to research ethics and engineering ethics.
Intellectual Property Strategy 1 credits Elective Required Professor Ishida Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.	**Research and Development of Information Electronics System** 2 credits Elective Required Professor Matsuura Researchers and developers who have conducted prominent research and product development will give lectures on background, objectives, originality, and research and development methods, using specific products and systems as examples, followed by discussions.
RF Measurement Engineering 2 credits Elective Required Professor Yabukami Learn the basics and practical measurement techniques of high-frequency measurement, which is important as basic measurement technology such as wireless information communication technology, energy transmission technology, and spintronics technology. Understand the relationship between transmission engineering in the microwave band, S-parameters, Smith charts and measurement technology, and the high-frequency performance of high-frequency parts and connectors, as well as measurement of typical high-frequency measurement equipment such as noise figure meters, spectrum analyzers, and network analyzers. Learn everything from principles to the ease of controlling performance. At the same time, practice Smith charts and design, create, and evaluate high-frequency components, master the basic usage and evaluation techniques of spectrum analyzers and network analyzers, and acquire appropriate high-frequency measurements with the accuracy and bandwidth necessary for research and development in graduate school.	**Domestic Internship Training** 1~2 credits Elective Required All Faculty During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.
International Internship Training 1~2 credits Elective Required All Faculty During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. outside Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand R & D planning, research, product development, manufacturing, quality control, group collaborative work, etc. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.	**Advanced Seminar** 1~2 credits Elective Required All Faculty The purpose is to cultivate the ability to understand and think for oneself by providing the opportunity to improve communication skills necessary to play a leading role in a specialized field in the future.

Special Lecture on Electrical Engineering A 1~2 credits Elective Required Professor Endoh These are special lectures on the latest academic research in a specialized field or on the creation and development of studies related to a specialized field.	**Writing and Presentation for English Technical Paper A** 2 credits Elective Required This course teaches reading and writing techniques for theoretical texts in science and engineering, as well as the English grammar that forms the basis for these techniques, in order to acquire the skills needed to write papers in English for the international dissemination of research results.
Seminar on Energy Device Engineering 6 credits Elective Required Professor Endoh T, Professor Endo Y, Professor Yabukami, Associate Professor Kuwahata, Associate Professor Muroga In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.	**Seminar on Electrical Energy System Engineering** 6 credits Elective Required Professor Saito, Professor Tsuda, Visiting Professor Yashima, Associate Professor Takahashi, Associate Professor Nagasaki In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.
Seminar on Intelligent Energy System Engineering 6 credits Elective Required Professor Ishiyama, Professor Ishiguro, Professor Sugita, Associate Professor Kano, Associate Professor Goto In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.	**Master's Thesis Research in Electrical Engineering** 8 credits Required All Faculty Students will be assigned to groups in Energy Device Engineering, Electrical Energy System Engineering, Intelligent Energy System Engineering, and participate in experiments and exercises including training presentations, discussions, and literature introductions.

授業科目表（MC）Opening of a course class subject list

Department of Communications Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	Signal Processing for Communications	Every year	JE		2		A student has to earn 4 or more credits from the major basic subjects listed in the left column.
	Wave Transmission Theory	Every year	JE		2		
	Communications Devices	Every year	JE		2		
	Foundations of Computer Software	Every year	JE		2		
	Electric Power Systems Engineering	Every year	JE		2		A student has to earn 6 or more credits from the major basic subjects in the left column including the above designated subjects.
	Power Electronics	Every year	JE		2		
	System Control Theory	Every year	JE		2		
	Foundations of Algorithms	Every second year	JE		2		
	Theory of Differential Equations	Every year	J		2		
	Thermodynamics and Statistical Mechanics	Every year	JE		2		
	Solid State Physics	Every year	JE		2		
	Introduction to Semiconductor Device Physics and Technology	Every year	J		2		
	Hardware Fundamentals	Every year	JE		2		
専門科目 Major General Subjects	Antennas and Propagation Engineering	Every second year	JE		2		A student has to earn 10 or more credits from the major general subjects listed in the left column or the related subjects offered by other departments.
	Optical Engineering for Information and Communication Technology	Every second year	JE		2		
	Applied Ultrasonics and Devices	Every second year	JE		2		
	Image Information Communications	Every second year	JE		2 2		
	Wireless Transmission Engineering	Every second year	JE		2		
	Optical Transmission Engineering	Every second year	JE		2		
	Information Storage Technology	Every second year	JE		2		
	Millimeterwave and Terahertz Electron Devices	Every second year	JE		2		
	Data Communication Engineering	Every year	JE		2		
	Fundamentals on Ultrasonic Engineering	Every second year	JE		2		
	Sound Media Engineering	Every year	JE		2		
	Communication System	Every second year	JE		2		
	Secure Information Communication Systems	Every second year	JE		2		
	Intellectual Property Strategy	Every year	J		1		
	Research and Development of Information Electronics System	Every year	J		2		

	RF Measurement Engineering	Every year	JE		2		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Advanced Seminar				1~2		
	Special Lecture on Communications Engineering A	Every year	J		1~2		
	Writing and Presentation for English Technical Paper A	Every year	E		2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Seminar on Intelligent Communication Network Engineering				6		A student has to earn 6 credits from one of the seminars listed in the left column.
	Seminar on Communication System Engineering				6		
	Seminar on Wave Engineering				6		
	Seminar on Wave Transmission Engineering				6		
	Master's Thesis Research in Communications Engineering			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Class Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

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Signal Processing for Communications 2 credits

Elective Required

Professor Ito, Professor Sakamoto, Associate Professor Nose

The lecture will cover the basic theory of communication signal processing (orthogonal transforms from Fourier transform to discrete cosine transform, z-transform and digital filter, wavelet transform, system identification and adaptive filtering), which has progressed rapidly in recent years with the development of computers. The purpose of this course is to map these mathematical foundations to engineering applications and to deepen understanding of communication signal processing techniques through exercises.

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~~Professor Yamada~~

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Associate Professor Fukidome

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Antennas and Propagation Engineering 2 credits

Elective Required

Professor Chen

This lecture presents the basics of antennas and radio wave propagation. First, the principle of antenna radiation and reception, characteristics of basic antennas, the principle of array antennas, and the characteristics of array antennas are introduced. Next, numerical analysis methods for radiation, scattering and diffraction of radio wave are explained as the boundary value problems of the wave equations. Finally, radio wave propagation on surface of the earth, through the ionosphere and the atmosphere, as well as radio wave propagation of mobile communications in a multipath propagation environment are discussed.

Optical Engineering for Information and Communication Technology 2 credits

Elective Required

Professor Matsuura

Starting from theory of the basic properties of light, the course develops into the basics of optical waveguides and transmission characteristics of optical fibers, and then covers theoretical methods for expressing and evaluating the basic characteristics of optical waveguides used in today's optical communication systems.

Applied Ultrasonics and Devices 2 credits

Elective Required

Professor Arakawa

This lecture covers the generation and propagation of ultrasonic waves and the acousto-optic interaction with light while understanding their applications, especially in medical and biological applications. In this lecture, first, the fundamentals and applications of linear and nonlinear propagation of ultrasonic waves will be explained, and then electroacoustic conversion by the piezoelectric effect will be explained. Then, its imaging applications, biological effects and therapeutic applications, the interaction between ultrasonic waves and microbubbles, the interaction between ultrasonic waves and light waves due to acousto-optic effects, and the operation of surface acoustic wave devices will be explained, aiming to make the principles your own enable to application yourself.

Image Information Communications 2 credits

Elective Required

Professor Omachi

This lecture gives the coding methods for efficient communication of images and videos. Beginning with the fundamental of digital images, the basics of encoding and the elemental technologies required for encoding are taught. It also outlines specific encoding methods such as JPEG and MPEG.

Wireless Transmission Engineering 2 credits

Elective Required

Professor Suematsu

This course will provide an overview of wireless communications, link design, and hardware design of transceiver RF blocks. Design of Rader system and beamforming system will also be introduced. All lectures will be given in Japanese.

Optical Transmission Engineering 2 credits Elective Required Professor Hirooka This lecture covers fundamentals of devices and systems in optical fiber communications based on the theory of lightwave and opto-electronics. The topics include optical fibers and pulse propagation, lasers, optical amplifiers, modulators, and detectors. Recent progress in optical communication such as optical solitons and digital coherent technologies will also be presented.	**Information Storage Technology** 2 credits Elective Required Associate Professor Greaves Information storage is the backbone of our information-based society. In order to cope with the enormous amount of multimedia information generated each year huge progress has been made in increasing the capacity and density of storage systems. At the core of these storage systems are hard disk drives and magnetic recording technologies. Lectures will include talks on magnetism and magnetic materials, recording and reproduction theory, digital signal processing, micromagnetics, etc., while also considering future technologies.
Millineterwave and Terahertz Electron Devices 2 credits Elective Required Professor Otsuji, Associate Professor Sato In this lecture, starting from the basic theory, students will learn about ultrahigh-speed semiconductor devices operating in the millimeter-wave/terahertz frequency ranges. They will also learn about applications of millimeter/terahertz electromagnetic waves to various information/communication technology.	**Data Communication Engineering** 2 credits Elective Required Professor Omachi, Professor Ito, Professor Chen, Professor Nishiyama, Professor Suematsu In this lecture, we will refer to actual examples of data communication networks, and learn about their configurations and the basic technology to realize them. First, data communication in wired communication, wireless communication, and optical communication network will be outlined. Next, transmission techniques for data communication such as coding, multiplexing, modulation/demodulation, etc. will be described in detail. In addition, the configuration and communication protocol of computer networks are described in detail.
Fundamentals on Ultrasonic Engineering 2 credits Elective Required Professor Yoshizawa The objective of this course is to provide students with an understanding of the physical fundamentals of ultrasonic waves, which are widely applied in nondestructive testing, medical diagnosis and treatment, and to enable them to use basic theories such as the wave equation. The course includes lectures on the wave equation of ultrasonic waves propagating in an elastic medium, directivity of ultrasonic wave transmitter/receiver, and methods of analyzing measured ultrasonic signals. Through exercises on them, students will acquire a deeper understanding and become familiar with the handling of basic theories.	**Sound Media Engineering** 2 credits Elective Required Professor Ito, Professor Sakamoto In communication systems, humans play a major role as transmitters and receivers of information. Therefore, it is essential to clarify the mechanism of human information processing in order to create a system that anyone can comfortably follow in any environment. In considering human information processing, a deep understanding of sound media and the auditory system that processes them is essential. In this class, we will discuss the fundamentals of sound media, the fundamentals of the auditory information processing process, and the advanced acoustic communication systems to realize a comfortable sound environment from the above perspectives. Multimodal information processing, such as audiovisual information integration, will also be discussed.
Communication System 2 credits Elective Required Professor Nishiyama The purpose of this course is to provide a broad overview of the basic technologies of communication systems. The course covers basic technologies of digital wireless communications, advanced technologies for mobile communications, and wireless communication network technologies.	**Secure Information Communication Systems** 2 credits Elective Required Professor Homma The objective is to learn the basics for building an information communication system securely. In this lecture, we first study the basics of modern cryptography, the fundamentals to construct information security. In particular, we learn about the algorithms and implementation of symmetric key and public key cryptography. We then learn about the outline of physical attacks applied to the implementation and countermeasures against them. On that basis, we learn related technologies such as next-generation cryptography, secure computing technique, hardware authentication, electromagnetic information security, and IoT security.

Intellectual Property Strategy 1 credits
Elective Required
Professor Ishida

Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.

Research and Development of Information Electronics System
Elective Required 2 credits
Professor Matsuura

Researchers and developers who have conducted prominent research and product development will give lectures on background, objectives, originality, and research and development methods, using specific products and systems as examples, followed by discussions.

RF Measurement Engineering 2 credits
Elective Required
Professor Yabukami

Learn the basics and practical measurement techniques of high-frequency measurement, which is important as basic measurement technology such as wireless information communication technology, energy transmission technology, and spintronics technology. Understand the relationship between transmission engineering in the microwave band, S-parameters, Smith charts and measurement technology, and the high-frequency performance of high-frequency parts and connectors, as well as measurement of typical high-frequency measurement equipment such as noise figure meters, spectrum analyzers, and network analyzers. Learn everything from principles to the ease of controlling performance. At the same time, practice Smith charts and design, create, and evaluate high-frequency components, master the basic usage and evaluation techniques of spectrum analyzers and network analyzers, and acquire appropriate high-frequency measurements with the accuracy and bandwidth necessary for research and development in graduate school.

Domestic Internship Training 1～2 credits
Elective Required
All Faculty

During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

International Internship Training 1～2 credits
Elective Required
All Faculty

During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. outside Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand R & D planning, research, product development, manufacturing, quality control, group collaborative work, etc. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

Advanced Seminar 1～2 credits
Elective Required
All Faculty

The purpose is to cultivate the ability to understand and think for oneself by providing the opportunity to improve communication skills necessary to play a leading role in a specialized field in the future.

Special Lecture on Communications Engineering A 1～2 credits
Elective Required
Professor Endoh

These are special lectures on the latest academic research in a specialized field or on the creation and development of studies related to a specialized field.

Writing and Presentation for English Technical Paper A 2 credits
Elective Required

This course teaches reading and writing techniques for theoretical texts in science and engineering, as well as the English grammar that forms the basis for these techniques, in order to acquire the skills needed to write papers in English for the international dissemination of research results.

Seminar on Intelligent Communication Network Engineering

Elective Required 6 credits

Professor Itoh, Associate Professor Nose

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Communication System Engineering 6 credits

Elective Required

Professor Omachi, Professor Matsuura, Professor Nishiyama

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Wave Engineering 6 credits

Elective Required

Professor Chen, Professor Yoshizawa,
Associate Professor Matsuda, Associate Professor Konno

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Wave Transmission Engineering 6credits

Elective Required

Professor Hanyu, Professor Otsuji, Professor Suematsu,
Professor Homma, Professor Hirooka,
Associate Professor Greaves, Associate Professor Sato,
Associate Professor Natsui, Associate Professor Kasai,
Associate Professor Onizawa

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Master's Thesis Research in Communication Engineering

Required 8 credits

All Faculty

Students will be assigned to groups in Intelligent Communication Network Engineering, Communication System Engineering, Wave Engineering, Wave Transmission Engineering, and participate in experiments and exercises including research presentations, discussions, and literature introductions.

授業科目表（MC）Opening of a course class subject list

Department of Electronic Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	Thermodynamics and Statistical Mechanics	Every year	JE		2		A Student has to earn 6 or more credits from the major basic subjects listed in the left column.
	Solid State Physics	Every year	JE		2		
	Introduction to Semiconductor Device Physics and Technology	Every year	J		2		
	Hardware Fundamentals	Every year	JE		2		
	Electric Power Systems Engineering	Every year	JE		2		
	Power Electronics	Every year	JE		2		
	System Control Theory	Every year	JE		2		
	Foundations of Algorithms	Every second year	JE		2		
	Signal Processing for Communications	Every year	JE		2		
	Wave Transmission Theory	Every year	JE		2		
	Communications Devices	Every year	JE		2		
	Foundations of Computer Software	Every year	JE		2		
	Theory of Differential Equations	Every year	J		2		
専門科目 Major General Subjects	Plasma Physics and Engineering	Every second year	JE		2		A student has to earn 10 or more credits form the major general subjects in the left column or the related subjects offered by other department.
	Plasma Application Engineering	Every second year	JE		2		
	Image Electronics	Every second year	JE		2		
	Information Measurement and Analysis	Every second year	J		2		
	Solid State Electroacoustic Devices	Every second year	JE		2		
	Microscopic Processing of Surfaces	Every year	J		2		
	Science of Advanced Nano-Processing	Every second year	JE		2		
	Electronic Materials and Processing	Every second year	JE		2		
	Molecular Electronics	Every second year	JE		2		
	Quantum Electronics	Every second year	JE		2		
	Spintronics Devices	Every year	JE		2		
	Fundamentals on Ultrasonic Engineering	Every second year	JE		2		
	Applied Ultrasonics and Devices	Every second year	JE		2		
	Sound Media Engineering	Every year	JE		2		
	Internet Engineering	Every second year	JE		2		
	Secure Information Communication Systems	Every second year	JE		2		
	Biosensing	Every second year	JE		2		
	Biophysics and Bioengineering	Every year	JE		2		
	Ethics of Engineering and Life	Every second year	J		2		
	Experiments in Medical and Bio-Electronics	Every year	JE		2		
	Intellectual Property Strategy	Every Year	J		1		
	Research and Development of Information Electronics System	Every year	J		2		
	RF Measurement Engineering	Every year	JE		2		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Advanced Seminar				1~2		

	Special Lecture on Electronic Engineering A	Every year	J		1~2		
	Writing and Presentation for English Technical Paper A	Every year	E		2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Seminar on Neoelectronic Engineering				6		A Student has to earn 6 credits from one of the seminars listed in the left column.
	Seminar on Electronic Control Engineering				6		
	Seminar on Material Science and Engineering				6		
	Seminar on Electronic System Engineering				6		
	Seminar on Electronic Device Engineering				6		
	Seminar on Electronics Materials				6		
	Seminar on Technology of Microscopic Processing of Surfaces				6		
	Master's Thesis Research in Electronic Engineering			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。
Students must acquire 30 or more credits from the subjects above.
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

Thermodynamics and Statistical Mechanics 2 credits
Elective Required
Professor Shirai

The aim of this class is to understand the basis of statistical mechanics, which gives methods to derive macroscopic properties of a system from the microscopic states of an ensemble of constituent particles. First, students will acquire the methods of statistical mechanics describing equilibrium states, and then learn the basis of statistical mechanics for understanding non-equilibrium phenomena, e.g. electric transport. Finally, students will understand the relationship between the response to an external field and the fluctuation of the relevant system, e.g. various physical properties of electronic and magnetic materials.

Solid State Physics 2 credits
Elective Required
Associate Professor Fukidome

Solid-state physics (SSP) in the 20th century was dedicated to analyze structures and functions of natural substances. Now in this 21st century, the goal of SSP has shifted to designing and synthesizing new materials, from the atomic level, to try to demonstrate required functions. Designing and synthesizing things to realize desired functionality is nothing but engineering; SSP-based engineering should be the mainstream in SSP in this century. Being focused on engineering, this class will proceed in a from-engineering-to-physics manner, not from-physics-to-applications manner as they do in the faculty of science. Another reason to take this order is to save time. Engineers usually do not have enough time to master all the essentials in SSP before going to specific topics. What is important here is to have right images on basic concepts in SSP to use them as a tool to understand emerging technologies and elaborate them. Conceptual understanding comes first before mathematical rigor. The class will focus on several topics specially selected in terms of importance in today's electronics and electrical engineering, but is open to those that form the physical basis of the research theme of the students. Students are required to be strongly motivated in attending the class.

Introduction to Semiconductor Device Physics and Technology 2 credits
Elective Required
Professor Kuroda, Associate Professor Sakuraba

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Hardware Fundamentals 2 credits
Elective Required
Professor Hanyu, Professor Hariyama,
Associate Professor Waidyasooriya

Students will learn the basics of integrated circuit technologies, processor architecture, and intelligent integrated systems that combine intelligent-processing techniques with integrated circuits.
Classes will focus in particular on (1) the outline and importance of intelligent integrated systems, (2) high-level synthesis techniques for high performance and low-power VLSI processors, (3) high-performance and low-lower CMOS integrated-circuit design techniques, (4) design method using reconfigurable processors such as FPGAs, (5) circuit-design techniques of high-performance VLSI whose performance would be degraded due to wiring complexity, (6) implementation techniques concerning power-supply lines and clock distribution, and (7) systematic design techniques of System-on-a-Chips.

Electric Power Systems Engineering 2 credits
Elective Required
Professor Saito

Students will learn the following basic technologies which are the most important parts for modern electric power systems to achieve stable and reliable supply and transmission of electric energy under the interconnection of large amounts of intermittent renewable energy such as photovoltaic generation and wind power generation.
(1) Frequency and active power control
(2) Voltage and reactive power control
(3) Power system security and power flow analysis
(4) Power system stability and its analysis methods

Power Electronics 2 credits
Elective Required
Professor Endoh

Power electronics is a technical field that converts and controls electric power using the switching action of power semiconductor devices.
The lecture reviews the history of power electronics, the operating principles and trends of power semiconductor devices, and the theory of operation of power conversion circuits.
In addition, various power electronics devices such as motor drive technology to control industrial machinery will be explained.

System Control Theory 2 credits
Elective Required
Professor Ishiguro, Professor Homma, Professor Sugita

To control large scale and multi variable dynamical systems such as robots, automobiles, and electrical plants, lectures on system control theory will be given on the basis of the state space control method.
Moreover, post modern control theories based on soft computing and bio-inspired methods will be explained.

Foundations of Algorithms 2 credits
Elective Required
Professor Zhou, Associate Professor Suzuki

Algorithms now play a very important role for the reliability and efficiency in several social systems. This course focuses on design and analysis of algorithms from the viewpoint of theoretical computer science. We deal with parallel algorithms, approximation algorithms, randomized algorithms etc. We also show some applications of algorithm theory to practical problems.

Signal Processing for Communications 2 credits
Elective Required
Professor Ito, Professor Sakamoto, Associate Professor Nose

The lecture will cover the basic theory of communication signal processing (orthogonal transforms from Fourier transform to discrete cosine transform, z-transform and digital filter, wavelet transform, system identification and adaptive filtering), which has progressed rapidly in recent years with the development of computers. The purpose of this course is to map these mathematical foundations to engineering applications and to deepen understanding of communication signal processing techniques through exercises.

Wave Transmission Theory 2 credits
Elective Required
Professor Chen, Professor Yoshizawa

This lecture presents the fundamental theories of radiation, propagation, diffraction, and scattering of radio waves, light waves, sound waves, and ultrasonic waves from viewpoint of wave engineering. Various applications of these wave phenomena are lectured as well.

Communications Devices 2 credits
Elective Required

This class forcus on study about communication devices used in today's wireless and wired communications. In the first half, the operation mechanisms of communication devices that have been softwarelaired will be lectured, and in the second half, optical fiber used for fiber-optic communication and semiconductor laser, optical amplifier, optical modulator, optical switch, optical multiplexer/demultiplexer and receiver will be lectured to understand the mechanisms and operating principles of optical devices.

Foundations of Computer Software 2 credits
Elective Required
Professor Sumii, Associate Professor Matsuda

Reliability of software is crucial in modern society where social infrastructures are controlled by computers. We lecture methods of understanding software with mathematical logic and discussing/verifying its behavior with rigor. Specifically, we cover computation models and their formal semantics that form the basis of software description, as well as software specification, verification, and type systems based on those models and semantics.

Theory of Differential Equations 2 credits
Elective Required
Professor Tanaka

1. The differential equations play a very important role in physics and engineering. In this lecture, students study some ordinary differential equations of a complex variable, some partial differential equations and the method of Green's function on the basis of the contents studied in the undergraduate course for the differential equations.
2. The main topics are as follows : integral representations of solutions for second order ordinary differential equations of a complex variable, partial differential equations, heat equations, Laplace's equation, Poisson's equation, the eigenvalue problem of partial differential equations and related Green's function method and so on.
3. Students study those topics by keeping application to engineering in mind, along with their fundamental concepts.

Plasma Physics and Engineering 2 credits
Elective Required
Professor Kaneko, Associate Professor Kato

Plasma, the fourth state of matter, is not only interesting from a physics point of view, but also extremely important in advanced nanoelectronics, bio/life sciences, exploration of new environments (magnetosphere, outer space), and development of long-term energy sources (nuclear fusion). In this course, students will systematically learn basic plasma engineering for application, such as basic equations of plasma, electrostatic and electromagnetic properties of plasma, atomic and molecular processes, generation and control of plasma, and characteristics of various types of discharges.

Plasma Application Engineering 2 credits
Elective Required
Professor Kaneko,
Associate Professor Kato, Associate Professor Takahashi

There are many application fields in plasma technology. Reactive plasma generation, chemical reactions with solid surfaces, plasma deposition and etching will be lectured, which are the basis of new material development and electronic material processing technologies. Plasma applications in space, environment, energy, nanotechnology, biotechnology, and medicine will also be lectured.

Image Electronics 2 credits
Elective Required
Professor Fujikake

Students will be taught the light-material interactions and human vision properties, which are the foundations of image electronics. Furthermore, as applied technology, the device principle and configuration of image sensing, recording, transmission, and display will be explained in image systems such as television.

Information Measurement and Analysis 2 credits
Elective Required
Associate Professor Arakawa

The purpose of this course is to systematically understand the basics of spectral analysis methods, including their physical meaning, for the effective use of wave information in measurements. Therefore, from the basics of maximum likelihood estimation, least squares method, eigenvalue expansion, singular value decomposition, pattern recognition, z-transform, discrete Fourier transform, spectral estimation method by autoregressive model, estimation of transfer function and coherence function, delay time Estimation and time-frequency analysis are described and practiced.

Solid State Electroacoustic Devices 2 credits
Elective Required
Associate Professor Yamasue

This course covers the mechanism of piezoelectric effect in piezoelectric materials used for solid-state electroacoustic devices, the basics of theoretical treatment of piezoelectric effect, and the derivation and analysis methods of piezoelectric vibration equations. The course also help students understand the various applications of piezoelectric devices.

Microscopic Processing of Surfaces 2 credits
Elective Required
Professor Kuroda, Professor Higurashi

Students will be taught the advanced topics on microscopic processing for manufacturing LSI, magnetic memories and displays. This course covers basics and deep knowledge on the topics as well as, the current issues and their possible solutions. Through the classes this course is targeted to provide students with the problem solving abilities. Classes will focus on the ultra-clean and high-density process technologies, nanoscale material design and measurements of solid-state surfaces, especially fabrications and measurements of highly scaled-down and three-dimensional structures.

Science of Advanced Nano-Processing 2 credits
Elective Required
Professor Saito, Associate Professor Sakuraba

This class provides comprehensive lectures on physical chemistry, ultrahigh vacuum science, materials science, and metallurgy, which are the basis of nano-processing technology in the fields of magnetic materials and semiconductors, including analytical and measurement techniques for evaluation.

Electronic Materials and Processing 2 credits
Elective Required
Associate Professor Sakuraba, Associate Professor Okada

This lecture will be given on the basic principle and elemental technologies of physics, manufacturing process, and semiconductor process that form the basis for constructing electronic devices and LSIs in the field of semiconductor, including material/device evaluation techniques.

Molecular Electronics 2 credits
Elective Required
Professor Hirano

This course provides the fundamentals of molecules and supramolecules related to molecular electronic devices, which are considered to play a central role in the next generation of electronics. The lecture covers the structure and electrical properties of organic materials, nanomaterials, and biomaterials, film formation and device fabrication, organic electronic devices, and molecular devices.

Quantum Electronics 2 credits
Elective Required
Professor Yasaka

Students will be taught the basics of quantum electronics including lasers, nonlinear optics and quantum optics, and their applications to opto-electronic devices.

Spintronics Devices 2 credits
Elective Required
Professor Ikeda, Professor Fukami,
Associate Professor Otsuka, Associate Professor Kanai

Spintronics utilizes two degrees of freedom of electrons, charge and spin, leading to realization of solid-state devices with new functionalities. Students will learn the fundamental mechanisms necessary to understand the applications of spintronics to functional devices, including injection, transport, and detection of spins in metals and semiconductors, quantum coherent dynamics of spins, and interaction between spins and magnetization, as well as the practical knowledge for nonvolatile memory devices, integrated circuits, artificial-intelligence hardware, and quantum computers.

Fundamentals on Ultrasonic Engineering 2 credits
Elective Required
Professor Yoshizawa

The objective of this course is to provide students with an understanding of the physical fundamentals of ultrasonic waves, which are widely applied in nondestructive testing, medical diagnosis and treatment, and to enable them to use basic theories such as the wave equation. The course includes lectures on the wave equation of ultrasonic waves propagating in an elastic medium, directivity of ultrasonic wave transmitter/receiver, and methods of analyzing measured ultrasonic signals. Through exercises on them, students will acquire a deeper understanding and become familiar with the handling of basic theories.

Applied Ultrasonics and Devices 2 credits
Elective Required
Associate Professor Arakawa

This lecture covers the generation and propagation of ultrasonic waves and the acousto-optic interaction with light while understanding their applications, especially in medical and biological applications. In this lecture, first, the fundamentals and applications of linear and nonlinear propagation of ultrasonic waves will be explained, and then electroacoustic conversion by the piezoelectric effect will be explained. Then, its imaging applications, biological effects and therapeutic applications, the interaction between ultrasonic waves and microbubbles, the interaction between ultrasonic waves and light waves due to acousto-optic effects, and the operation of surface acoustic wave devices will be explained, aiming to make the principles your own enable to application yourself.

Sound Media Engineering 2 credits
Elective Required
Professor Ito, Professor Sakamoto

In communication systems, humans play a major role as transmitters and receivers of information. Therefore, it is essential to clarify the mechanism of human information processing in order to create a system that anyone can comfortably follow in any environment. In considering human information processing, a deep understanding of sound media and the auditory system that processes them is essential. In this class, we will discuss the fundamentals of sound media, the fundamentals of the auditory information processing process, and the advanced acoustic communication systems to realize a comfortable sound environment from the above perspectives. Multimodal information processing, such as audiovisual information integration, will also be discussed.

Internet Engineering 2 credits
Elective Required
Professor Kato, Professor Kawamoto

The Internet is the infrastructure that drives the "information society". It has become the most important mean of information exchange and supports
One of the important means of information exchange most of our daily activities. Every device connected to the Internet operates according to the Internet Protocol, or IP. Thus, to understand how the Internet works, it is fundamental to learn how IP works.
In this class, the outline and basics of IP will be explained. Students will also be able to experience the causes of network congestion and mechanism behind its resolution through practical training using a network simulator. Finally, we will explore how next-generation network environments integrate wired and wireless IP, what kind of problems can arise in this scenario, and what are the possible solutions to these issues.

Secure Information Communication Systems 2 credits
Elective Required
Professor Homma

The objective is to learn the basics for building an information communication system securely. In this lecture, we first study the basics of modern cryptography, the fundamentals to construct information security. In particular, we learn about the algorithms and implementation of symmetric key and public key cryptography. We then learn about the outline of physical attacks applied to the implementation and countermeasures against them. On that basis, we learn related technologies such as next-generation cryptography, secure computing technique, hardware authentication, electromagnetic information security, and IoT security.

Biosensing 2 credits
Elective Required
Professor Yoshinobu, Professor Hirano,
Associate Professor Miyamoto

Students will learn the principles of electrochemical, optical, and other sensing methods for the detection and quantification of various chemical species related to biology. They will also learn the basics of physical chemistry and biochemistry as well as applications and research topics such as cell membrane sensors, neurophysiology, biochips, and MEMS.

Biophysics and Bioengineering 2 credits
Elective Required
Professor Toyabe, Associate Professor Nakamura

Life phenomena basically originate in cellular nanometer-scale phenomena. In this lecture, students will learn about the latest technologies to observe and control such small-scale phenomena. In particular, genetic engineering, microscopy, and microscopic control techniques will be studied in detail. The course does not require prerequisite knowledge of life phenomena, as it will be taught in conjunction with basic knowledge of life science.

Ethics of Engineering and Life 2 credits
Elective Required
Specially Appointed Assistant Professor Han Luo

The purpose of this lecture is to provide an opportunity for students as engineers to think about the future from a broad perspective. Industrial development since the Industrial Revolution has been accelerating day by day, and our daily lives are also undergoing rapid changes. However, if we are blinded by such changes, we may lose sight of the goal that science and technology should originally aim at: the promotion of people's happiness. In this course, we will review the interface between engineering and society in relation to life. This is because modern engineering has reached the realm of direct and indirect contact with “life”. When engineering is involved in fields such as medicine and food, it is confronted with situations that directly affect the life and death of humans and other living organisms. There is no small possibility that environmental problems resulting from the massive consumption of materials and energy will threaten the survival of our living organisms. To broadly consider these issues, lecturers from various fields such as engineering, medicine, and welfare will be invited to give lectures and hold discussions. In addition, there will be opportunities for group presentations on issues related to research ethics and engineering ethics.

Experiments in Medical and Bio-Electronics 2 credits

Elective Required

Professor Yoshinobu, Professor Hirano,

Associate Professor Miyamoto

During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

Intellectual Property Strategy 1 credits

Elective Required

Professor Ishida

Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.

Research and Development of Information Electronics System Electronics System 2 credits

Elective Required

Professor Matsuura

Researchers and developers who have conducted prominent research and product development will give lectures on background, objectives, originality, and research and development methods, using specific products and systems as examples, followed by discussions.

RF Measurement Engineering 2 credits

Elective Required

Professor Yabukami

During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

Domestic Internship Training 1~2 credits

Elective Required

All Faculty

During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

International Internship Training 1~2 credits

Elective Required

All Faculty

During the two weeks to one month of the master's or doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. outside Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand R & D planning, research, product development, manufacturing, quality control, group collaborative work, etc. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

Advanced Seminar 1~2 credits

Elective Required

All Faculty

The purpose is to cultivate the ability to understand and think for oneself by providing the opportunity to improve communication skills necessary to play a leading role in a specialized field in the future.

Special Lecture on Electronic Engineering A 1～2 credits

Elective Required

Professor Endoh

These are special lectures on the latest academic research in a specialized field or on the creation and development of studies related to a specialized field.

Writing and Presentation for English Technical Paper A
Elective Required 2 credits

This course teaches reading and writing techniques for theoretical texts in science and engineering, as well as the English grammar that forms the basis for these techniques, in order to acquire the skills needed to write papers in English for the international dissemination of research results.

Seminar on Neoelectronic Engineering 6 credits
Elective Required
Professor Saito, Associate Professor Ogawa

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Electronic Control Engineering 6 credits
Elective Required
Associate Professor Arakawa

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Material Science and Engineering 6 credits
Elective Required
Professor Kaneko, Professor Kitamura,
Associate Professor Tsunoda,
Associate Professor Kato,Associate Professor Okada

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Electronic System Engineering 6 credits
Elective Required
Professor Fujikake, Professor Higurashi, Professor Yoshinobu,
Professor Watanabe, Professor Kodama,
Associate Professor Kanzaki, Associate Professor Miyamoto,

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Electronic Device Engineering 6 credits
Elective Required
Professor Yasaka, Professor Ikeda, Professor Hirano,
Professor Fukami, Associate Professor Yamasue,
Associate Professor Hiranaga, Associate Professor Yoshida,
Associate Professor Otsuka, Associate Professor Yokota,
Associate Professor Kanai

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Electronics Materials 6 credits
Elective Required
Professor Shirai,
Associate Professor Abe,

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Seminar on Technology of Microscopic Processing of Surfaces 6 credits
Elective Required
Professor Kuroda, Professor Sato, Professor Shimazu,
Associate Professor Sakuraba, Associate Professor Fukidome,
Associate Professor Yamamoto

In order to broaden the scope of knowledge, lectures will include the following exercises: introduction of the contents of research related to the master's thesis research, discussion based on the introduction of research contents, and introduction of the contents of representative or recent domestic and international research papers and references related to the master's thesis research.

Master's Thesis Research in Electronic Engineering
Required 8 credits
All Faculty

Students will be assigned to groups in Spin Nano-Electronic Engineering, Electronic Control Engineering, Material Science and Engineering, Electronic System, and participate in experiments and exercises including research presentations, discussions, and literature introductions.

授業科目表（MC）Opening of a course class subject list

Department of Applied Physics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	Statistical Physics	Every year	JE		2		A Student has to earn 8 or more credits form the major basic subjects listed in the left column.
	Elementary Solid State Physics	Every year	JE		2		
	Structural Physics of Materials	Every year	JE		2		
	Low Temperature Physics and Superconductivity Physics	Every year	JE		2		
	Physics of Magnetism	Every second year	JE		2		
	Optical Physics and Photonic Materials	Every year	JE		2		
	Introduction to Semiconductor Device Physics and Technology	Every year	J		2		
	Biophysics and Bioengineering	Every year	JE		2		
専門科目 Major General Subjects	Physics of Strongly-correlated Systems						
	Quantum Physics	Every second year	JE		2		
	Physics of Magnetic Materials	Every second year	JE		2		
	Physics of Low Temperature Magnetism	Every second year	JE		2		
	Applied Material Science						
	High Field Superconducting Materials	Every second year	JE		2		
	Science and Technology of Electronic Materials A				2		
	Science and Technology of Electronic Materials B				2		
	Introduction to Advanced Magnetics A	Every second year	JE		2		
	Introduction to Advanced Magnetics B	Every second year	JE		2		
	Semiconductor optoelectronics A	Every second year	JE		2		
	Optical Properties of Semiconductor B				2		
	Synchrotron Radiation Soft X-ray Microscopy	Every second year	JE		2		
	Synchrotron Radiation Science	Every second year	JE		2		
	Atomic, Molecular & Optical Physics	Every second year	JE		2		
	Biosensing	Every second year	JE		2		
	Ethics of Engineering and Life	Every year	J		2		
	Experiments in Bio-and Nano-Electronics	Every year	JE		2		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		

	Special Lecture on Applied Physics A				1~4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Seminar on Applied Interface Physics				2		A Student has to earn 2 credits from one of the seminars listed in the left column.
	Seminar on Applied Condensed Matter Physics				2		
	Seminar on Applied Material Physics				2		
	Seminar on Low Temperature Materials				2		
	Seminar on Electron and Photon Measurements				2		
	Seminar on Applied Material Science				2		
	Special Seminar on Applied Physics		JE	2			
	Master's Thesis Research in Applied Physics			8			

1，上記科目の単位数を合わせて 30 単位以上を修得すること。
Students must acquire 30 or more credits from the subjects above.
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
"Class Schedule" is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

Statistical Physics 2 credits
Elective Required
Associate Professor Tsuchiura, Associate Professor Yoshidome

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Elementary Solid State Physics 2 credits
Elective Required
Professor Matsueda, Associate Professor Shimizu

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Structural Physics of Materials 2 credits
Elective Required
Professor Miyazaki, Associate Professor Hayashi

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Low Temperature Physics and Superconductivity Physics 2 credits
Elective Required
Professor Yamashita, Associate Professor Kato

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Physics of Magnetism 2 credits
Elective Required
Professor Oogane

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Optical Physics and Photonic Materials 2 credits
Elective Required
Professor Ono, Associate Professor Terakado

The lecture covers the concept of light and the interaction of light with electrons and lattices in solids, for example, optical properties of semiconductors, ionic crystals, dielectrics, and metals. In addition, Optical absorption, light scattering, and luminescence based on electrons, holes, excitons are considered. Electronic states and optical responses of nanostructures in solids will be described as well.

Introduction to Semiconductor Device Physics and Technology 2 credits
Elective Required
Professor Suemitsu, Associate Professor Sakuraba

The purpose of this lecture is to acquire the basis for a unified understanding of electron theory of solids from its fundamentals to device operation. Electron kinetics in solids, electron and hole behavior at semiconductor junctions and boundaries and basic principles of MOS transistor operation, etc. will be lectured.

Biophysics and Bioengineering 2 credits
Elective Required
Professor Toyabe, Associate Professor Nakamura

Life phenomena basically originate in cellular nanometer-scale phenomena. In this lecture, students will learn about the latest technologies to observe and control such small-scale phenomena. In particular, genetic engineering, microscopy, and microscopic control techniques will be studied in detail. The course does not require prerequisite knowledge of life phenomena, as it will be taught in conjunction with basic knowledge of life science.

Physics of Strongly-correlated Systems 2 credits

Based on the fundamentals of quantum mechanics, statistical mechanics, and solid state physics, the physics of strongly correlated electron systems will be lectured. The lecture starts with a review of the Hartree-Fock approximation, which is a method to treat wavefunctions of many-electron systems in the mean-field approximation, and then metal-insulator transition in the Hubbard model and ferromagnetism of metals will be reviewed. The lecture will also review the method of treating strongly correlated lattice models beyond the mean-field approximation (tensor product state method), and will cover the physics of systems in which itinerancy (conductivity) and localization (magnetism) coexist.

Quantum Physics 2 credits
Elective Required
Associate Professor Watanabe

The purpose of this course is to introduce quantum-mechanical methods to describe many-electron systems and their interaction with light. Based on the methods, we discuss the electronic structures of atoms and molecules, and learn photo absorption, emission, and scattering phenomena, together with various spectroscopic methods. Students are expected to obtain the principle of methods to describe atoms, molecules, and their interaction with photons.

Physics of Magnetic Materials 2 credits

Elective Required

Professor Mizukami

I lecture physics of nano to pico second spin dynamics in magnetic materials and (potential) device application, including modern spintronics technology. First, fundamental concepts of magnetism, e.g., magnetic moment and magnetic anisotropy, are revisited. Then, the phenomenological equation of motion for magnetization is introduced to understand the physics behind rf- circulator and isolator. Later half of this lecture, I also discuss optical characterization technique to measure spatio-temporal spin dynamics, such as light scattering measurement, THz electromagnetic wave measurement, and pump/probe measurements using an ultrafast pulse laser.

Physics of Low Temperature Magnetism 2 credits

Elective Required

Associate Professor Kimura

Purpose of this course is to learn the magnetic properties of localized spin systems, mainly the magnetism in antiferromagnetic systems. In the first half of the course, basic matters of magnetism, which include magnetic anisotropy, exchange interaction in localized spin systems, general properties of phase transitions, are presented. Then, topics such as quantum fluctuation in a low dimensional magnet, geometrical frustration, magnetoelectric effect and spin crossover phenomena, are introduced.

Applied Material Science 2 credits

Elective Required

Physical properties of materials are based on their crystal structures and electronic structures. Students will learn how to comprehend the relation between them. Classes will focus on (1) crystal structure analysis, (2) (composite) crystals, (3) electronic and thermal transport properties, (4) electronic structure calculations, and (5) introduction of energy harvesting materials (thermoelectric materials, photovoltaic materials, etc.).

High Field Superconducting Materials 2 credits

Elective Required

Professor Awaji, Associate Professor Tsuchiya

Practical superconducting materials have some functions for a safety and stable operation of high performance superconducting applications. The lecture covers a basic superconducting property, superconducting materials function and magnet applications in the practical superconducting materials. In particular, new concepts and its applications with high temperature superconducting materials will be studied in comparison to conventional low temperature materials.

Science and Technology of Electronic Materials A 2 credits

Elective Required

Physics of semiconductors, materials, and electronic devices, and their specific devices will be consistently discussed. The topics covered are (1) semiconductor band theory, (2) quantum structures and their properties, (3) two-dimensional electron gas, (4) relationship between material properties and device performance index, (5) high frequency transistors, (6) high power transistors, (7) bulk single crystal growth, (8) epitaxial growth of single crystal films, and (9) device fabrication (9) device fabrication process. The historical development and current status of these processes will also be discussed. In particular, the system application aspects of the devices will be mentioned, and bottom-up discussions from the viewpoint of materials and devices will be made for realization of useful systems in the future. The way of working and research methods in the society will also be introduced.

Science and Technology of Electronic Materials B 2 credits

Elective Required

Classification of semiconductors as electronic materials, mixed crystals and heterostructures, fundamentals and details of thin film fabrication, and evaluation methods of their physical properties will be lectured. (1) Material properties of semiconductors, (2) Basics of heterostructure, (3) Basics of thin film fabrication, (4) Methods of compound semiconductor thin film fabrication, (5) In-situ observation methods, (6) Physical property evaluation methods

Introduction to Advanced Magnetics A 2 credits

Elective Required

Professor Okamoto

Ferromagnetic materials have been widely utilized in modern society such as data storage device, high-efficiency motor, passive components of power-electronics circuit, and so on. In these devices, magnet size and operation time are widely spread from nanometer to meter scale and from picosecond to second scale, respectively. This lecture starts from the basic theories and physical properties of ferromagnetic materials, and then spin dynamics and magnetization reversal mechanism are explained. Finally, actual engineering applications of magnetic materials are covered.

Introduction to Advanced Magnetics B 2 credits

Elective Required

Associate Professor Kikuchi

Magnetic materials are used in wide applications from energy industry to electronics and information technologies. In this course, basic physics of magnetic materials and their applications will be lectured. Experimental methods related to magnetic materials in a wide range of temporal/special scales will be discussed.

Semiconductor optoelectronics A 2 credits
Elective Required
Professor Chichibu

Basic to advanced aspects of semiconductor optoelectronic devices such as light-emitting diodes (LEDs) and laser diodes (LDs) will be given. For understanding those device operating principles, materials science for several compound semiconductors and their alloys will be given. For example, structures and operation principles of (Al, Ga, In) (N, P, As) LEDs and LDs will be introduced.

Optical Properties of Semiconductor B 2 credits
Elective Required
Associate Professor Shima

The goal of this course is to provide students with basic knowledge of semiconductor photophysical properties, with examples of experimental and theoretical studies. In addition to the basic overview of semiconductors, excitonic properties, quantum nanostructures, wide bandgap semiconductors, and various spectroscopic methods will be explained.

Synchrotron Radiation Soft X-ray Microscopy 2 credits
Elective Required
Professor Takata, Associate Professor Ejima,
Associate Professor Yamamoto

Synchrotron Radiation(SR) has been a revolutionary and invaluable research tool for a wide range of science & technology, including physics, materials science, chemistry, biology, etc. It will be also found multidisciplinary applications in DX/GX. The fundamentals of storage ring operations, the qualities of the synchrotron radiation produced, the x-ray optics required to transport this radiation, and the detectors used for measurements will be described. The important measurement techniques that use synchrotron x-rays of new SR facility; NanoTerasu, including x-ray absorption, x-ray fluorescence, x-ray scattering, x-ray photoemission, coherent diffraction imaging, etc. will be introduced.

Synchrotron Radiation Science 2 credits
Elective Required
Associate Professor Ejima

Number of synchrotron radiation sources are used worldwide as light sources for nm-scale analysis and evaluation of materials. In the lecture, the characteristics of synchrotron radiation will be reviewed, then it will be introduced that the optical properties of X-rays and their interaction with materials, optical elements and experimental techniques for using X-rays, spectroscopic studies and nanoscopic observation methods using X-rays, and industrial applications such as semiconductor lithography devices.

Atomic, Molecular & Optical Physics 2 credits
Elective Required
Professor Takahashi

Many phenomena that occur around us can be understood from a point of view that the natural world is made up of atoms and molecules. This is the material reason why Atomic, Molecular & Optical (AMO) Physics, which studies how particles of matter (atoms, molecules, and clusters) interact both with one another and with particles of electron and light, has a long history beginning in the early 20th century, has always been setting itself within new scholarly frontiers, and has been extending its application to a broad of fields in natural science and technology. This course offers an opportunity to learn about the basic of AMO physics and its current frontiers.

Biosensing 2 credits
Elective Required
Professor Yoshinobu, Professor Hirano,
Associate Professor Miyamoto

Students will learn the principles of electrochemical, optical, and other sensing methods for the detection and quantification of various chemical species related to biology. They will also learn the basics of physical chemistry and biochemistry as well as applications and research topics such as cell membrane sensors, neurophysiology, biochips, and MEMS.

Ethics of Engineering and Life 2 credits
Elective Required
Specially Appointed Assistant Professor Han Luo

The purpose of this lecture is to provide an opportunity for students as engineers to think about the future from a broad perspective. Industrial development since the Industrial Revolution has been accelerating day by day, and our daily lives are also undergoing rapid changes. However, if we are blinded by such changes, we may lose sight of the goal that science and technology should originally aim at: the promotion of people's happiness. In this course, we will review the interface between engineering and society in relation to life. This is because modern engineering has reached the realm of direct and indirect contact with “life”. When engineering is involved in fields such as medicine and food, it is confronted with situations that directly affect the life and death of humans and other living organisms. There is no small possibility that environmental problems resulting from the massive consumption of materials and energy will threaten the survival of our living organisms. To broadly consider these issues, lecturers from various fields such as engineering, medicine, and welfare will be invited to give lectures and hold discussions. In addition, there will be opportunities for group presentations on issues related to research ethics and engineering ethics.

Experiments in Medical and Bio-Electronics 2 credits
Elective Required
Professor Yoshinobu, Professor Hirano,
Associate Professor Miyamoto

Students will learn interdisciplinary areas at the interface between electronics and biology through various basic experiments related to bio-electronics and biomedical engineering.

Domestic Internship Training 1~2 credits
Elective Required
All Faculty

The trainees will receive one-week to one-month on-the-job training in practical training and research activities at a company in Japan. Through this training, trainees will gain hands-on experience and understanding of planning, research, product development, manufacturing, quality control, and group work at companies, etc. Trainees will submit a training report to the training site and their supervisor. The trainee submits a training report to the training site and the supervisor. 1 credit is given for training of 40 hours or more, and 2 credits for training of 80 hours or more.

International Internship Training 1~2 credits
Elective Required
All Faculty

The trainees will receive one-week to one-month on-the-job training in practical training and research activities at a company outside of Japan. Through this training, trainees will gain hands-on experience and understanding of planning, research, product development, manufacturing, quality control, and group work at companies, etc. Trainees will submit a training report to the training site and their supervisor. The trainee submits a training report to the training site and the supervisor. 1 credit is given for training of 40 hours or more, and 2 credits for training of 80 hours or more.

Special Lecture on Applied Physics A 1~4 credits
Elective Required

The program aims to promote professional knowledge of doctoral training by introducing the latest specialized and advanced research results by the faculty members in charge and lecturers from outside the university.

Seminar on Applied Interface Physics 2 credits
Elective Required
Professor Mizukami, Professor Oogane

Seminar on giant magneto-resistive effect in multi-layered magnetic thin films and tunnel magneto-resistive effect in ferromagnet/insulator/ferromagnet junctions. In addition, seminar on the novel spintronic phenomena and their practical applications.

Seminar on Applied Condensed Matter Physics 2 credits
Elective Required
Professor Fujiwara, Professor Matsueda, Professor Ono,
Associate Professor Shimizu, Associate Professor Tsuchiura,

Students will be assigned to a seminar for each area of specialization, where they will present their master's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Seminar on Applied Material Physics 2 credits
Elective Required
Professor Miyazaki, Professor Toyabe, Professor Yamashita,
Associate Professor Kato, Associate Professor Hayashi,
Associate Professor Nakamura, Associate Professor Terakado

Students will be assigned to a seminar for each area of specialization, where they will present their master's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Seminar on Low Temperature Materials 2 credits
Elective Required
Professor Awaji, Associate Professor Kimura,
Associate Professor Tsuchiya

Students will be assigned to a seminar for each area of specialization, where they will present their master's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Seminar on Electron and Photon Measurements 2 credits
Elective Required
Professor Takahashi, Professor Chichibu, Professor Takada,
Associate Professor Watanabe, Associate Professor Ejima,
Associate Professor Yamamoto, Associate Professor Shima

Students will be assigned to a seminar for each area of specialization, where they will present their master's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Seminar on Applied Material Science 2 credits
Elective Required
Professor Okamoto, Associate Professor Kikuchi

Students will be assigned to a seminar for each area of specialization, where they will present their master's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Special Seminar on Applied Physics 2 credits
Required
Professor Chichibu, Professor Takahashi,
Associate Professor Nakamura

In this lecture, students will present academic papers written in English related to their research topics, as well as the results and progress of their own research. Students are expected to deepen their understanding of the basic knowledge and expertise of their research topics through these presentations. In addition, the students will also learn how to read academic papers critically, how to give oral presentations, and how to prepare themselves. Students those who attend each seminar are also required to attend this lecture.

Master's Thesis Research in Applied Physics 8 credits Required All Faculty The program consists of literature surveys, discussions, exercises, experiments, research presentations, and other activities related to the research topic to be conducted in the process of preparing the master's thesis, the specific contents of which will be determined by the supervising professor.	

(MC) Opening of a course class subject list

Department of Applied Chemistry

Category	Subject	Schedule	Language	Credit			Remarks
				Required	Elective Required	Elective	
Major Basic Subjects	Physical Chemistry of Molecules	Every year	JE		2		Students must get at least 6 credits from the Major Basic Subjects listed on the left side.
	Advanced Chemistry of Organic Resources	Every year	JE		2		
	Chemistry of Advanced Inorganic Materials	Every year	JE		2		
	Organometallic Chemistry	Every year	JE		2		
	Environmental Resource Chemistry	Every year	JE		2		
	Advanced Coordination Chemistry	Every year	E		2		
	Chemistry of Nano-Structured Polymer Materials	Every year	JE		2		
	Synthetic Chemistry and Characterization of Hybrid Materials	Every year	JE		2		
	Interfacial Chemistry	Every year	JE		2		
	Materials Chemistry with Optical Functions	Every year	JE		2		
	Environmental Inorganic Chemistry	Every year	JE		2		
	Chemistry of Reactions on Inorganic Materials	Every year	JE		2		
	Chemistry of Organic Electronics	Every year	JE		2		
	Chemistry of Energy Conversion	Every year	JE		2		
	Chemistry of Self-Assembling Polymeric Materials	Every year	JE		2		
	Synchrotron X-ray Analysis for Materials Chemistry	Every year	JE		2		
Major General Subjects	Major Basic Subjects in Chemical Engineering Major Basic Subjects in Biomolecular Engineering						
	Seminar on Atomic and Molecular Control Engineering	Every year	JE		4		Students must get 4 credits from the seminars listed on the left side.
	Seminar on Chemistry for Resources and Environment	Every year	JE		4		
	Seminar on Chemistry of Molecular Systems	Every year	JE		4		
	Seminar on Control of Materials Function	Every year	JE		4		
	Topics in Applied Chemistry	Every year				1~2	
	Chemical English for Engineering/Engineers	Every year	E			2	
	Internship Training	Every year				1~2	
	Master Thesis Research in Applied Chemistry	Every year		6			
Related Subjects of Other Majors	Those approved by the Educational Committee of the Graduate School of Engineering						

1, At least 20 credits must be obtained from the subjects listed in the Major Basic and Major General Subjects. Also, at least 30 credits must be obtained from the Subjects Listed in the Major Basic, Major General, and Related Subjects of Other Majors.
2, "Class Schedule" is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3, Language Key
E:（Lectures given in English）
JE:（Lectures understandable for Japanese and foreign students）
J:（Lectures given in Japanese）

Physical Chemistry of Molecules【TACCHE501】 2 credits Elective Required Professor Keisuke Asai Associate Professor Yutaka Fujimoto Research in atomic, molecular, and optical (AMO) science and engineering discovers itself at the apex of investigations ranging from fundamental studies in quantum mechanics to the development of new nano-technologies. This series of lectures entitled *Physical Chemistry of Molecules* is designed to provide a firm understanding of atoms and molecules, their interaction with external fields, and how to exploit various optical processes to manipulate light. While some familiarity with quantum mechanics and electromagnetic theory is assumed, students with limited or no knowledge of AMO fields will find this course a good introduction.	**Advanced Chemistry of Organic Resources【TACPRE501】** 2 credits Elective Required Professor Keiichi Tomishige Associate Professor Yoshinao Nakagawa Efficient utilization of organic resources such as petroleum, natural gas, coal, and biomass becomes more and more important, where catalytic chemical conversion processes are key technologies. In this subject, the conversion processes of organic resources will be discussed in views of heterogeneous catalysis and reactions. The methods for catalyst characterization, determination of reaction mechanism, and selectivity control will be explained.
Chemistry of Advanced Inorganic Materials【TACMSE502】 2 credits Elective Required Professor Hirotsugu Takizawa Associate Professor Yamato Hayashi Design of functional inorganic materials is based on the knowledge of crystal chemistry, phase equilibria, solid state physics, etc. The aims of this class are to provide introductions to inorganic synthesis under high temperature, high pressure, electric and magnetic fields, characterization of solids, and the concepts for material design by microstructure developments on the basis of solid state chemistry. The current topics of advanced inorganic materials are discussed.	**Organometallic Chemistry【TACAPC501】** 2 credits Elective Required Professor Shuichi Oi Senior Assistant Professor Shinya Tanaka Organometallic compounds, especially organo-transition metal compounds, which have carbon-metal bonds and are located at the boundary between organic and inorganic chemistry, will be lectured on synthetic methods, structure and bonding, reactivity, catalysis, and applications to synthetic organic reactions.
Environmental Resource Chemistry【TACAPC502】 2 credits Elective Required Professor Toshiaki Yoshioka Associate Professor Shogo Kumagai Lectures on chemical processes for manufacturing chemical products with a low environmental impact, and chemical reactions, processes, and systems for recycling waste industrial products as raw materials and fuels while reducing environmental impact.	**Advanced Coordination Chemistry【TACAPC503】** 2 credits Elective Required Professor Nobuhiko Iki Coordination chemistry dealing with synergy between metal ions and ligands has departed from the field of classical inorganic chemistry for a wide variety of interdisciplinary fields such as analytical, materials, bioinorganic, and biomedical chemistry. To explore the fields, understanding of the basic concepts of coordination chemistry as well as the comprehensive back ground of the topics are essential. This course helps students to gain those basics by dealing with hot topics in the current coordination chemistry.
Chemistry of Nano-Structured Polymer Materials【TACMAC502】 2 credits Elective Required Professor Masaya Mitsuishi The lecture will be given for topics related to polymer materials science, especially to polymer organized assemblies and polymer thin films. Electronic, dielectric, and photonic properties of polymer thin film assemblies will be discussed. Nano-technology in the fabrication of molecular assembled devices is also given.	**Synthetic Chemistry and Characterization of Hybrid Materials【TACMAC503】** 2 credits Elective Required Professor Kiyoshi Kanie Senior Assistant Professor Masaki Matsubara Development of high-performance materials is quite important for the sustainable future life. Hybrid material is a representative material exhibiting to show synergistic functions of organic and inorganic materials. This course explains design and synthesis of the hybrid materials focusing on the nano- or molecular-level interactions between organic and inorganic matters. Furthermore, this course also discusses characterization methods of the nano-level self-organized structures and the structure-dependent functions of the hybrid materials.
Interfacial Chemistry【TACAPC504】 2 credits Elective Required Professor Yuji Matsumoto Associate Professor Shingo Maruyama A basic understanding of interfacial charge transfer and chemical reactions, including crystal growth, is important for the development of electrochemical devices such as fuel cells and photocatalysts and solid-state devices such as solar cells and transistors. In this lecture, we will provide the following topics from a chemist's point of view: the electronic states of solids, the energy transfer reactions at the metal-liquid interface based on Marcus theory, the current-voltage characteristics at different semiconductor interfaces based on semiconductor physics, and the charge transfer phenomena at the liquid-solid interfaces in photocatalysis and Li ion secondary batteries.	**Materials Chemistry with Optical Functions【TACMAC504】** 2 credits Elective Required Professor Masaru Nakagawa Associate Professor Tomoya Oshikiri This course aims to understand optical functions of materials and functionalization by photochemical reactions. The basics of optics, light-matter interactions, and analytical methods by optics will be reviewed. Additionally, cutting-edge materials for photoresist pattering and nanoimprint lithography will be introduced. Mechanisms of optical functions of materials will be discussed from the hierarchical viewpoints of materials such as molecules, thin films, crystals, and nanoparticles.

Environmental Inorganic Chemistry【TACMAC505】

2 credits　Elective Required
Professor Shu Yin
Senior Assistant Professor Takuya Hasegawa

This lecture focuses on the synthesis of inorganic materials by soft chemical reactions with low environmental load, and lectures on the synthesis of inorganic materials that can be used for environmental purification and their reaction design. Inorganic chemical technology related to environmental purification, structural analysis of　materials and separation/decomposition of environmental pollutants, will be also introduced.

Chemistry of Reactions on Inorganic Materials【TACMAC507】

2 credits　Elective Required
Professor Hideki Kato

Carbon-free and carbon-neutral technology is essential for realization of the sustainable society. This course introduces chemical reactions over inorganic materials which contribute to the carbon-free and carbon neutral society and helps students understand the relationships between reactions and properties of inorganic materials, such as crystal structure, band structure, and surface structure. In addition, this course deepens knowledge about the geometry of crystals that is important to understand function of inorganic materials.

Chemistry of Organic Electronics【TACAPC505】

2 credits　Elective Required
Professor Tomoyuki Akutagawa

Organic electronics is a next-generation device that is attracting attention from the viewpoints of flexibility of device structure and diversity of functional design. In order to design the conductivity and magnetism of molecular assemblies from the design of the frontier orbitals of organic compounds and the molecular arrangement in crystals, the lecture will cover the fundamentals to understand the molecular design of π-electron compounds, crystal structures, band structures, and their physical properties. Charge-transfer complexes made from electron donors and electron acceptors will be taken as examples. The students will learn about the synthesis of molecules, X-ray crystallography, electrical conductivity, and magnetic susceptibility.

Chemistry of Energy Conversion【TACCHE502】

2 credits　Elective Required
Professor Itaru Honma
Associate Professor Saneyuki Ohno
Senior Assistant Professor Kazuyuki Iwase

This lecture covers fundamental science and technology of energy conversion devices such as solar cells, fuel cells, and secondary batteries, that are very important to renewable energy systems and a global sustainability. Fuel cells and secondary batteries are electrochemical devices that converts electrical energy to chemical energy and vice versa with much higher efficiencies than combustion engines for example. To understand mechanisms of the energy conversion, we study relevant sciences of thermodynamics, physical chemistry, solid state physics, solid state chemistry, electrochemistry and reaction dynamics.

Chemistry of Self-Assembling Polymeric Materials【TACMAC506】

2 credits　Elective Required
Professor Hiroshi Jinnai
Senior Assistant Professor Tomohiro Miyata

Polymers and their alloys self-assemble via phase transitions to form complex structures, in some cases, nano-scale structures. The equilibrium and nonequilibrium (nano-) structures generated in the self-assembling processes are essential for bottom-up (nano-) materials using polymers. This lecture explains such self-assembling routes of polymers from the thermodynamics viewpoint. In addition, the precise evaluation methods (advanced microscopy techniques in particular) for nano- to micron-scale three-dimensional (3D) structures generated during the self-assembling process will be discussed.

Synchrotron X-ray Analysis for Materials Chemistry【TACMAC508】

2 credits　Elective Required
Professor Maiko Nishibori

Analytical techniques using synchrotron X-rays are essential for clarifying materials' structure and electronic and chemical states. For example, X-ray absorption spectroscopy can provide information on the electronic states and the local structures of absorbing atoms. In this course, students will learn various material analysis methods using synchrotron X-rays and the basic knowledge necessary to analyze electronic states and local structures. They will also deepen their understanding of experimental studies on material chemistry using synchrotron X-ray analysis.

Seminar on Atomic and Molecular Control Engineering【TACOEN601】

4 credits　Elective Required
Professor Yuji Matsumoto
Associate Professor Shingo Maruyama

Students, through working as a group member of the Atomic and Molecular Control Engineering, are expected to develop skills that are required to discuss the research of their master's thesis and introduce the latest research papers related to their study.

Seminar on Chemistry for Resources and Environment【TACOEN602】

4 credits　Elective Required
Professor Keiichi Tomishige
Professor Masaya Mitsuishi
Associate Professor Shogo Kumagai
Associate Professor Yoshinao Nakagawa

Belonging to Environmental Resources Chemistry group so that the introduction of research outline on master-degree studies, the discussion based on them, and the introduction of typical and/or recently issued original papers on these themes.

Seminar on Chemistry of Molecular Systems【TACOEN603】 4 credits　Elective Required Professor Hirotsugu Takizawa Professor Keisuke Asai Associate Professor Yamato Hayashi Associate Professor Yutaka Fujimoto In this seminar, students belonging to the Chemistry of Molecular Systems Group will introduce the research on the structure-property relationship of solid state materials related to their master thesis and have a discussion based on it.	**Seminar on Control of Materials Function【TACOEN604】** 4 credits　Elective Required Prof. Shuichi Oi　Prof. Tomoyuki Akutagawa Prof. Masaru Nakagawa　Prof. Hiroshi Jinnai Prof. Hideki Kato　Assoc. Prof.Tomoya Oshikiri Senior Assistant Prof. Shinya Tanaka Senior Assistant Prof. Tomohiro Miyata The course will include the introduction of the contents of the master's thesis research on Control of Materials Function, discussion based on it, and the practice such as introduction of representative or recent research papers related to this topic.
Topics in Applied Chemistry【TACOEN605】 1~2 credits　Elective Subjects The aim of this class it is to provide the students an opportunity to deepen the knowledge about and thereby further increase their interest in science and engineering by face-to-face listening to a distinguished researcher's lecture about his/her advanced research achievements and the related topics.	**Chemical English for Engineering/Engineers【TACOCH601】** 2 credits　Elective Subjects Associate Professor Fabio Pichierri Lectures, demonstrations, and practical training will be given on the following items: ・Basic guidelines on writing scientific and technical papers in English. ・Reading and critical discussion of research papers published in scientific journals covering the fields of Applied Chemistry, Chemical Engineering, and Biomolecular Engineering. ・Fundamentals of technical communication in English. ・Group discussions in English on chemistry-related topics
Internship Training【TACOEN606】 1~2 credits　Elective Subjects Prior to the start of the internship with a company or an organization in which you are trained, a meeting will be held with a department professor. The student should submit a registration sheet on your plan and a report on your training before and after the internship, respectively. One credit is given for the internship period of two weeks or more, and two credits are given for a month or more. However, the internship is limited to that based on on the "Basic Concept for Promoting Internships" agreed upon by the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labor and Welfare, and the Ministry of Economy, Trade and Industry (2022.6.13).	**Master Thesis Research in Applied Chemistry【TACOEN607】** 6 credits　Required Subjects Students, through working as a group member of Atomic and Molecular Control Engineering, Resources and Environment, Molecular Chemistry Systems, or Control Materials Function, are expected to develop skills that are required to clearly present and fully discuss about literature and research results.

(MC) Opening of a course class subject list

Department of Chemical Engineering

Category	Subject	Schedule	Language	Credit: Required	Credit: Elective Required	Credit: Elective	Remarks
Major Basic Subjects	Energy Process Engineering	Every year	JE		2		Students must get at least 6 credits from the Major Basic Subjects listed on the left side
	Material Process Engineering	Every year	JE		2		
	Reaction Process Engineering	Every year	JE		2		
	Design and Optimization of Process Systems	Every year	JE		2		
	Multi-Phase Process Design Engineering	Every year	JE		2		
	Statistical Thermodynamics	Every year	JE		2		
	Supercritical Fluid Engineering	Every year	JE		2		
	Design of Solid Materials	Every year	JE		2		
	Nanomaterials Design and Engineering	Every year	JE		2		
Major General Subjects	Major Basic Subjects in Applied Chemistry Major Basic Subjects in Biomolecular Engineering						
	Seminar on Transport Phenomena	Every year	JE		4		Students must get 4 credits from the seminars listed on the left side.
	Seminar on Chemical Process Engineering	Every year	JE		4		
	Seminar on Process Systems Engineering	Every year	JE		4		
	Seminar on Reaction and Separation Process	Every year	JE		4		
	Topics in Chemical Engineering	Every year				1~2	
	Chemical English for Engineering/Engineers	Every year	E			2	
	Internship Training					1~2	
	Master Thesis Research in Chemical Engineering	Every year		6			
Related Subjects of Other Majors	Those approved by the Educational Committee of the Graduate School of Engineering						

1,At least 20 credits must be obtained from the subjects listed in the Major Basic and Major General Subjects. Also, at least 30 credits must be obtained from the Subjects Listed in the Major Basic, Major General, and Related Subjects of Other Majors.

2, "Class Schedule" is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3, Language Key

E: (Lectures given in English)

JE: (Lectures understandable for Japanese and foreign students)

J: (Lectures given in Japanese)

Energy Process Engineering【TCEPRE502】

2 credits　Elective Required

Professor Hideyuki Aoki

The aim of the class is to understand the principles of energy conversion and the associated environmental impacts. Principles and processes necessary to understand the prevention of air pollution associated with combustion phenomena will be lectured. Specifically, 1) fuels, 2) combustion calculations, 3) combustion technologies, and 4) formation mechanisms and countermeasures for environmental pollutants will be explained.

Material Process Engineering【TCEPRE503】

2 credits　Elective Required

Professor Daisuke Nagao

Associate Professor Keishi Suga

High-dimensional control over structures of materials is essential to develop new functional materials. Not only physical properties relating to phase equilibrium but also transport phenomena relating to phase separations should be clarified to deeply understand the relationship between material structures and the operation factors to create new functions of the materials. In the lecture targeting for organic polymer materials, inorganic materials, and composites of organic and inorganic materials, reaction conditions and practical operation factors will be explained for advanced controls over micro-scaled structures and phase structures of materials leading to new functional products.

Reaction Process Engineering【TCEPRE504】

2 credits　Elective Required

Professor Naomi Shibasaki-Kitakawa

Associate Professor Atsushi Takahashi

For students who have studies reaction engineering and biological reaction engineering as undergraduates, this lecture will cover the kinetic analysis of heterogeneous phase reaction processes such as immobilized enzyme reactions and solid catalytic reactions, and the rational design and operation methods of industrial reactors for such processes. In addition, kinetic analysis of practical complex processes that simultaneously perform reactions and separations, their rational design and operation methods, and how to set operating conditions for process scale-up will be introduced with case examples.

Design and Optimization of Process Systems【TCEPRE505】

2 credits　Elective Required

Professor Yasuhiro Fukushima

Associate Professor Hajime Ohno

In this lecture the students will learn how to identify, formulate, interpret the results, reformulate the optimization problems. They will also learn optimization algorithms and mathematical modeling methods for chemical process systems and product life cycle systems.

Multi-Phase Process Design Engineering【TCEPRE506】

2 credits　Elective Required

Professor Masaki Kubo

Considering that many processes, including chemical industrial processes, are consisted of multi phases, this lecture provides the fundamentals of interfacial phenomena such as surface tension and wetting, transport phenomena through an interface, and nano- and mezo-scale phenomena involving different interfaces Also, the lecture provides the modeling and numerical simulation methods of phenomena for design and control of multi-phase processes.

Statistical Thermodynamics【TCECHE503】

2 credits　Elective Required

<<Not open at the present>>

Statistical mechanics is a theoretical physics that studies, using probability theory, the average behavior of a mechanical system made up of a large number of equivalent components where the microscopic realization of the system is uncertain or undefined. A common use of statistical mechanics is in explaining the thermodynamic behavior of large systems.

This lecture treats the thermo-physical properties of gases, liquids and solids, and equilibrium and non-equilibrium states. Fundamentals of this lecture are statistics, thermodynamics and physical chemistry.

Supercritical Fluid Engineering【TCEPRE507】

2 credits　Elective Required

Professor Masaru Watanabe

Associate Professor Masaki Ota

Equilibrium and transport properties of supercritical fluids and various applications using them as media for separation, dispersion and their applications as a medium for separation, dispersion, material production, and reaction operations. The principles and characteristics of various applications and processes using supercritical fluids as media for separation, dispersion, material production, and reaction operations will be systematically lectured. In addition, the course will also cover In addition, the course will systematically introduce the objective solvent selection methods for chemical processes and the and methods of proposing technological innovations and new processes. In this course, students will also learn how to select a solvent for a specific purpose in a chemical process and how to propose innovations and new processes.

Design of Solid Materials【TCEMAC507】

2 credits　Elective Required

Professor Hirotomo Nishihara

This course aims to gain fundamental and practical insights into the design and analysis of solid materials and solid-based chemical reactions. This course illustrates synthesis techniques and structure design of non-crystalline materials, especially carbon materials. Specifically, this course emphasizes the analysis techniques in non-crystalline solid materials. Students will learn the relation between the structure of solid-based materials and their properties, the guideline as well as the methodology for materials design, and appropriate structure-analysis methods. This course also provides knowledge on practical applications of solid materials.

Nanomaterials Design and Engineering【TCEPRE509】

2 credits　Elective Required

Professor Takaaki Tomai

Senior Assistant Professor Kazuyuki Iwase

The approaches for nanomaterials and their products design will be explained, and their manufacturing processes will be discussed.Through the lecture for nanomaterials and their product development, this course focused on the methodology of problem solving based on chemical engineering.

Seminar on Transport Phenomena【TCEOEN608】

4 credits　Elective Required

Professor Hideyuki Aoki

Students who belong to the research group of Transport Phenomena learn how to survey and introduce latest domestic and international research papers related to their thesis research. Discussions and exercises related to their thesis research are also be conducted.

Seminar on Chemical Process Engineering【TCEOEN609】

4 credits　Elective Required

Professor Daisuke Nagao

Professor Naomi Shibasaki-Kitakawa

Associate Professor Keishi Suga

Associate Professor Atsushi Takahashi

The objective of this seminar is educating for students to review the literatures relating to their thesis researches in the laboratories of chemical process engineering.

Seminar on Process Systems Engineering【TCEOEN610】

4 credits　Elective Required

Professor Masaki Kubo

Associate Professor Fabio Pichierri

The latest research related to process system engineering is surveyed and introduced. Discussion and exercises are conducted based on these studies.

Seminar on Reaction and Separation Process【TCEOEN611】

4credits　Elective Required

Professor Masaru Watanabe

Professor Hirotomo Nishihara

Professor Takaaki Tomai

Associate Professor Masaki Ota

Senior Assistant Professor Kazuyuki Iwase

The seminar provides how to survey and introduce the latest domestic and international research related to their master's thesis research in the Reaction and Separation Process Group, and discuss and practice based on the results of the survey and introduction.

Topics in Chemical Engineering【TCEOEN612】

1~2 credits　Elective Subjects

The aim of this class is to provide the students an opportunity to deepen the knowledge about and thereby further increase their interest in science and engineering through a distinguished researcher's lecture explaining advanced research achievements and their related topics.

Chemical English for Engineering/Engineers【TCEOCH602】

2 credits　Elective Subjects

Associate Professor Fabio Pichierri

Lectures, demonstrations, and practical training will be given on the following items:

・Basic guidelines on writing scientific and technical papers in English.

・Reading and critical discussion of research papers published in scientific journals covering the fields of Applied Chemistry, Chemical Engineering, and Biomolecular Engineering.

・Fundamentals of technical communication in English.

・Group discussions in English on chemistry-related topics

Internship Training【TCEOEN613】

1~2 credits　Elective Subjects

Prior to the start of the internship with a company or an organization in which you are trained, a meeting will be held with a department professor.

The student should submit a registration sheet on your plan and a report on your training before and after the internship, respectively.

One credit is given for the internship period of two weeks or more, and two credits are given for a month or more. However, the internship is limited to that based on on the "Basic Concept for Promoting Internships" agreed upon by the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labor and Welfare, and the Ministry of Economy, Trade and Industry (2022.6.13).

Master Thesis Research in Chemical Engineering【TCEOEN614】

6 credits　Required Subjects

Students who belong to the research groups of Energy Process Engineering, Chemical Process Engineering, Process Systems Engineering and Reaction and Separation Processes perform experiments and exercises related to their research themes, including research presentation, discussion, and introduction of research articles.

(MC) Opening of a course class subject list

Department of Biomolecular Engineering

Category	Subject	Schedule	Language	Credit: Required	Credit: Elective Required	Credit: Elective	Remarks
Major Basic Subjects	Applied Biochemistry	Every year			4		Students must get at least 6 credits from the Major Basic Subjects listed on the left side.
	Advanced Organic Chemistry Ⅰ	Every year			2		
	Advanced Organic Chemistry Ⅱ	Every year			2		
	Molecular Biological Engineering	Every year	JE		2		
	Enzymes, Metabolism, and Bioengineering	Every year	JE		2		
	Biosensing Chemistry	Every year	JE		2		
	Environment-Benign Molecular Design and Synthesis	Every year	JE		2		
	Applied Biophysical Chemistry	Every year	JE		2		
	Organic and Bio-Materials Chemistry	Every year	JE		2		
Major General Subjects	Major Basic Subjects in Applied Chemistry Major Basic Subjects in Chemical Engineering						
	Seminar on Applied Life Chemistry	Every year	JE		4		Students must get 4 credits from the seminars listed on the left side.
	Seminar on Bioorganic Chemistry	Every year	JE		4		
	Seminar on Biofunctional Chemistry	Every year	JE		4		
	Seminar on Biological Organic Chemistry	Every year	JE		4		
	Topics in Biomolecular Engineering	Every year				1~2	
	Chemical English for Engineering/Engineers	Every year	E			2	
	Internship Training	Every year				1~2	
	Master Thesis Research in Biomolecular Engineering	Every year		6			
Related Subjects of Other Majors	Those approved by the Educational Committee of the Graduate School of Engineering						

1, At least 20 credits must be obtained from the subjects listed in the Major Basic and Major General Subjects. Also, at least 30 credits must be obtained from the Subjects Listed in the Major Basic, Major General, and Related Subjects of Other Majors.
2, "Class Schedule" is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3, Language Key
E: (Lectures given in English)
JE: (Lectures understandable for Japanese and foreign students)
J: (Lectures given in Japanese)

Applied Biochemistry【TBEBIO501】

4credits　Elective Required

The credits of this lecture will be obtained by attending Tohoku University Joint Lectures on Biochemistry which will be held in every Wednesday morning in the Faculty of Agriculture (or online), and fulfilling the requirements. The biological field-related research in the fields of medicine, medicine, science, agriculture, and engineering, such as biochemistry, molecular biology, cell biology, and molecular genetics, is lectured in omnibus format.

Advanced Organic Chemistry Ⅰ【TBECHE504】

2 credits　Elective Required

The standard lecture contents of organic chemistry at Tohoku University Graduate School will be explained in omnibus format by professors or associate professors of organic chemistry.

Advanced Organic Chemistry Ⅱ【TBECHE505】

2 credits　Elective Required

The standard lecture contents of organic chemistry at Tohoku University Graduate School will be explained in omnibus format by professors or associate professors of organic chemistry.

Molecular Biological Engineering【TBEBIO502】

2 credits　Elective Required
Professor Mitsuo Umetsu
Associate Professor Hikaru Nakazawa

The lectures of genetic engineering, gene expression system, protein structure and structural analysis are given, and the application of protein engineering based on their technologies are introduced.

Enzymes, Metabolism, and Bioengineering【TBEBAB501】

2 credits　Elective Required
Associate Professor Seiji Takahashi

Basic and applied aspects of useful biological functions, metabolism, and enzymes of living systems, especially those of plants and microorganisms, will be discussed. The topics that this class subject deals with will include (i) protein engineering and industrial applications of microbial and plant enzymes, (ii) microbial biochemistry of alcoholic fermentation and its industrial application, (iii) biochemistry, regulation, and application of plant specialized metabolism, and (iv) metabolic engineering for the production of useful compounds.

Biosensing Chemistry【TBEAPC507】

2 credits　Elective Required
Professor Hitoshi Shiku
Associate Professor Kosuke Ino
Associate Professor Hiroya Abe

This course is intended to understand: (1) the reactions of biomolecules. (2) functions of bio-membranes. (3) basics of biosensig from the electrochemical view points. Also important aims of this course are to enhance the ability for: (4) investigating recent progress of biosensing researches from literature. (5) summarize the investigation results.

Environment-Benign Molecular Design and Synthesis【TBEAPC508】

2 credits　Elective Required
Professor Tetsutaro Hattori
Associate Professor Naoya Morohashi

In order to realize environment-benign synthetic organic chemistry, it is necessary to create, design, and/or apply chemical substances, as well as production processes, which can reduce the formation or utilization of harmful materials or remove them. In the first half of this course, you will learn the basics of molecular recognition chemistry and the design of catalysts, and utilization of alternative reagents or reaction fields intended to reduce environmental loading, taking syntheses of enantiopure compounds as examples. In the second half, you will learn examples for the development of capturing and separation materials for organic molecules and metal ions based on the design of functional host molecules.

Applied Biophysical Chemistry【TBEBIO503】

2 credits　Elective Required
Professor Nobuyuki Uozumi
Associate Professor Yasuhiro Ishimaru

Organisms have sophisticated mechanisms to maintain homeostasis and adapt to changes in their environment. This lecture will explain the structures and functions of membrane devices, including ions, small molecules, signaling substances, molecules, and transporters involved in these mechanisms. Attendees will also have the opportunity to research and discuss membrane signaling pathways, membrane potential, and ion gradients, as well as the research methods used to understand them. They will be encouraged to investigate and analyze these topics independently.

Organic and Bio-Materials Chemistry【TBEMAC510】

2 credits　Elective Required
Professor Hitoshi Kasai
Senior Assistant Professor Kouki Oka

Lectures on organic and bio-based materials that are currently being put into practical use or are about to be put into practical use, mainly from the perspective of materials chemistry. Specifically, topics such as optoelectronic functional materials such as liquid crystals, pigments, and pharmaceuticals will be taken up, and current practical products to next-generation materials will be explained from the chemical aspect. Depending on the situation, I plan to give lectures by researchers of companies developing organic materials.

Seminar on Applied Life Chemistry【TBEOEN615】

4 credits　Elective Required
Associate Professor Seiji Takahashi

Students will be assigned to the Applied Life Chemistry group and discuss the results and perspectives of their master thesis research. They will also have seminars concerning recent advances of related research field by using recently published papers.

Seminar on Bioorganic Chemistry【TBEOEN616】

4 credits　Elective Required
Professor Hitoshi Shiku
Professor Tetsutaro Hattori
Associate Professor Kosuke Ino
Associate Professor Naoya Morohashi
Associate Professor Hiroya Abe

Students belong to the Bioorganic Chemistry Group, and conduct exercises such as introduction of research contents on master's thesis research, discussions based on it, and introduction of representative or the latest domestic and international research papers related to the same theme.

Seminar on Biofunctional Chemistry【TBEOEN617】

4 credits　Elective Required
Professor Nobuyuki Uozumi
Professor Mitsuo Umetsu
Associate Professor Yasuhiro Ishimaru
Associate Professor Hikaru Nakazawa

Students who belong to the research group of Biofunctional Chemistry group perform the exercises of the introduction and discussion of the research and research articles related to master thesis research or the latest research articles.

Seminar on Biological Organic Chemistry【TBEOEN618】

4 credits　Elective Required
Professor Hitoshi Kasai
Senior Assistant Professor Kouki Oka

Students, Belonging to the Bioorganic Chemistry Group,　will introduce
research content related to master's thesis research, discuss based on it, and introduce representative or latest domestic and foreign research papers related to the same theme.

Topics in Biomolecular Engineering【TBEOEN619】

1~2 credits　Elective Subjects

The opportunity to deepen the knowledge about and thereby further increase interest in science and engineering is provided by listening to a distinguished researcher's lecture about his/her advanced research achievements and the related topics.

Chemical English for Engineering/Engineers【TBEOCH603】

2 credits　Elective Subjects
Associate Professor Fabio Pichierri

Lectures, demonstrations, and practical training will be given on the following items:
・Basic guidelines on writing scientific and technical papers in English.
・Reading and critical discussion of research papers published in scientific journals covering the fields of Applied Chemistry, Chemical Engineering, and Biomolecular Engineering.
・Fundamentals of technical communication in English.
・Group discussions in English on chemistry-related topics

Internship Training【TBEOEN620】

1~2 credits　Elective Subjects

Prior to the start of the internship with a company or an organization in which you are trained, a meeting will be held with a department professor.
The student should submit a registration sheet on your plan and a report on your training before and after the internship, respectively.
One credit is given for the internship period of two weeks or more, and two credits are given for a month or more. However, the internship is limited to that based on on the "Basic Concept for Promoting Internships" agreed upon by the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labor and Welfare, and the Ministry of Economy, Trade and Industry (2022.6.13).

Master Thesis Research in Biomolecular Engineering【TBEOEN621】

6 credits　Required Subjects

Students who belong to research groups of Applied Life Chemistry, Bioorganic Chemistry, and Biofunctional Chemistry perform experiments and exercises related to their research themes, such as research presentation, discussion, and introduction of research articles.

授業科目表（MC）Opening of a course class subject list

Department of Metallurgy

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	製錬・精製の熱力学 Thermodynamics of Smelting & Refining	every year	JE		2		
	製錬・精製の速度論 Reaction Kinetics in Metallurgical Processes	every year	JE		1		
	材料表面界面科学 Science of Surfaces and Interfaces in Materials	every year	JE		2		
	相変態論 Theory of Phase Transformations	every year	J&E		2		
	量子化学 Quantum Chemistry	every year	J		1		
	材料電気化学 Materials Electrochemistry	every year	JE		2		
	疲労と破壊の材料学 Fatigue Strength and Fracture of Materials	every year	E		2		
	格子欠陥論 Lattice Defects Theory	every year	E		2		
	材料構造評価学 Structural Characterization of Materials	every year	JE		1		
	固体電子論 Physics of Electrons in Solids	every year	JE		2		
	理論材料学 Materials Theory	every year	E		1		
専門科目 Major General Subjects	結晶物理工学 Crystal Physics and Engineering	every year	JE		1		
	鉄鋼プロセス学 Iron and Steelmaking Process	every year	JE		1		
	非鉄金属プロセス学 Noufirrous Extractive Metallurgy	every year	JE		1		
	応用塑性加工学 Advanced Plastic Forming	every year	J		1		
	応用粉体加工学 Applied Powder Processing and Powder Metallurgy	every year	E		1		
	応用接合工学 Advanced Welding and Joining Engineering	every year	JE		1		
	数値材料プロセス学 Numerical Methods for Materials Processing	every year	JE		2		
	弾塑性力学 Mechanics of Elasticity and Plasticity	every year	JE		1		
	計算材料学 Computational Materials Science	every year	JE		1		
	エネルギー変換・機能材料学 Energy Conversion and Functional Materials	every year	E		1		
	磁気デバイス材料学 Magnetic Device Materials	every year	JE		2		
	応用電子材料学 Materials Science of Electronic and Optoelectronic Devices	every year	JE		1		

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門科目 Major General Subjects	非平衡物質工学 Nonequilibrium Materials	every year	JE		1		
	先端材料評価学 Advanced Materials Characterization	every year	JE		1		
	材料計測学 Evaluation of Materials	every year	E		1		
	生体材料学 Biomaterials Science	every year	E		1		
	ソフトマテリアル Soft Materials	every year	E		1		
	ナノ構造制御機能発現工学 Nanostructures and Function Control in Materials	every year	E		2		
	光機能材料概論 Functional Optical Materials	every year	E		1		
	先進鉄鋼工学 Advanced Steel Engineering	every year	J		2		
	非鉄金属製錬環境科学特論 Non-ferrous Metallurgical and Environmental Science and Engineering	every year	J		1		
	インターンシップ研修 Internship training				1～2		
	材料科学工学特別講義 Special Lectures on Material Science and Engineering						
	材料科学工学特別研修 Special Seminar on Material Science and Engineering						
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	金属プロセス工学セミナー Seminar on Metallurgical Process Engineering	every year			4		
	創形創質プロセス学セミナー Seminar on Materials Forming and Structural Control	every year			4		
	先端マテリアル物理化学セミナー Seminar on Advanced Materials Physical Chemistry	every year			4		
	プロセス設計学セミナー Seminar on Material Processing Design	every year			4		
	プロセス制御学セミナー Seminar on Materials Processing Control	every year			4		
	金属フロンティア工学修士研修 Research for Master's Thesis in Metallurgy	every year			6		

1，上記科目の単位数を合わせて 30 単位以上を修得すること。
Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
"Class Schedule" is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

Thermodynamics of Smelting & Refining 2 credits
製錬・精製の熱力学
Elective Required
Prof. Hiroyuki Shibata, Hongmin Zhu, Shigeru Ueda, Takahiro Miki
Associate Prof. Sohei Sukenaga

The goal of this lecture is to apply the basic knowledge already learned about chemical thermodynamics necessary for the production of metal materials and the creation of new materials of steel and non-ferrous metals to actual smelting and refining processes, and to improve it to a level where they can be analyzed using thermodynamics. In the first half, as the basis for analyzing the material manufacturing process, multicomponent phase equilibrium, reaction path and phase analysis, electrochemistry, potential diagrams, thermodynamics, structure, physical properties (measurement method), solution model, etc. of melts and solutions are explained, and in the second half, steel smelting (iron and steelmaking) and non-ferrous metal smelting (base metals such as copper, zinc, lead, and rare metals) processes, Deepen understanding by introducing examples and exercises on analysis methods using chemical thermodynamics.

Reaction Kinetics in Metallurgical Processes 1 credit
製錬・精製の速度論
Elective Required
Prof. Hiroshi Nogami, Associate Prof. Shungo Natsui

The fundamental concepts of material processes are designed based on thermodynamics. It is necessary to evaluate and/or estimate the rate-determining process quantitatively for their actual process designs. In this course, the students will learn about the several kinetic processes that are taken out from the actual smelting and refining processes. In this lecture, we will introduce how the reaction kinetics and transport kinetics that we have learned so far are applied to the analysis of the phenomena that occur in the actual refining process. Specific topics will be type of reactor, mass balance, and kinetic analysis of gas-solid/gas-liquid heterogeneous reactions.

Science of Surfaces and Interfaces in Materials 2 credits
材料表面界面科学
Elective Required
Prof. Naoya Masahashi, Yoshitaka Kasukabe, Tomomasa Wadayama,
Associate Prof. Kozo Shinoda

While the property of solid material originated from a volumetric property covering the whole solid, the atomic coordination is unsaturated on the surface of the solid, and the atomic arrangement is disturbed at the interface in the solid. Since these disordered atomic arrangements have a great influence on the physical properties of surfaces and interfaces, they form a discipline called surface and surface science. The purpose of this lecture is to understand various surface and interface phenomena in industrially important processes from the standpoint of basic physical properties. Specifically, in the first half, lectures will be given on the atomic arrangement of solid surfaces, thermodynamics and chemical bonds between surfaces and interfaces, and surface functions. In the second half, lectures will be given on analytical methods using ions for evaluating solid surfaces and thin film growth.

Theory of Phase Transformations 2 credits
相変態論
Elective Required
Prof. Ryosuke Kainuma, Yuji Sutou, Tetsu Ichitsubo, Toshihiro Ohmori

The purpose of the course is to make the participants understand the basic issues on phase transformations in materials on the basis of thermodynamics of microstructures. The main contents are ①phase diagrams and free energy (regular solution and sub-lattice models and phase equilibrium), ② thermodynamics on phase interface (grain boundary segregation and grain growth), ③diffusion phenomena (Fick's laws and phenomenological diffusion equation), ④thermodynamics on nucleation, ⑤martensitic transformations (crystallographic phenomenological theory and transformation hysteresis and interval) and ⑥thermodynamics on microstructural change (JMAK equation and eutectic and eutectoid transformations).

Quantum Chemistry 1 credit
量子化学
Elective Required
Prof. Momoji Kubo, Associate Prof. Yusuke Ootani
Specially Appointed Associate Prof. Yayoi Terada

Most functions and properties of materials can be understood from the behaviors of atoms and electrons in materials. Conversely, understanding the behaviors of atoms and electrons realizes the theoretical design of the materials with high performance and functions. Here, understanding the behavior of electrons requires knowledge on the concept and method of quantum chemistry. Basics of quantum chemistry is Schrödinger equation and molecular orbital theory has grown and advanced on the basis of the Schrödinger equation. Solving electronic states of materials by molecular orbital theory and computer realizes the understanding and predicting of the functions and properties of materials. In this class, 1) atomic orbital and molecular orbital, 2) molecular orbital theory, 3) Hückel theory, and 4) band theory of solids are given for understanding the basics of the quantum chemistry. Textbook: Atkins Physical Chemistry (1), Tokyo Kagaku Doujin.

Materials Electrochemistry 2 credits
材料電気化学
Elective Required
Prof. Izumi Muto, Hongmin Zhu,
Associate Prof. Osamu Takeda, Yu Sugawara

The purpose of this course is to understand the theory and practical application of electrochemistry in materials science. This course is arranged into three parts. The first part deals with fundamentals of electrochemical equilibrium and reaction kinetics on metal electrodes in terms of electron transfer. In the second part, the method of electrochemical measurements is described. Third part covers characteristics of industrial electrolysis (chlor-alkali process, electrowinning of zinc, electrowinning of aluminum) and key points for establishing industrial electrolysis.

Fatigue Strength and Fracture of Materials 2 credits
疲労と破壊の材料学
Elective Required
Prof. Naoyuki Nomura, Kyosuke Yoshimi, Yoshikazu Ohara

The lecture will cover fatigue phenomena and fatigue strength of materials, fracture mechanics and fracture toughness, and the basics of fatigue crack initiation and propagation mechanisms, from the viewpoint of not only understanding microscopic phenomena of materials, but also how macroscopic deformation and fracture of materials are correlated with microscopic phenomena. The course will explain how these concepts can be applied to materials engineering and how macroscopic fracture mechanics parameters can be utilized to ensure the safety and reliability of structures.

Lattice Defects Theory 2 credits
格子欠陥論
Elective Required
Prof. Kyosuke Yoshimi, Associate Prof. Nobuaki Sekido

Material properties strongly depend on the type and concentration of lattice defects in the material. Lattice defects are always introduced in a certain amount by synthesis or processing, and their type and concentration change depending on the operating environment. Therefore, knowledge and understanding of the types and concentrations of lattice defects and their measurement methods are essential for material design to exploit the excellent properties of materials fully and to maintain stable properties over the long term. In this lecture, the structure and physical properties of point defects, line defects (dislocations), and plane defects in materials will be outlined, and the behavior of these lattice defects in materials and their effects on material properties will be introduced. Furthermore, examples where lattice defects play a vitally important role from a practical standpoint, such as irradiation damage, and methods for measuring lattice defect concentration will also be presented.

Structural Characterization of Materials 1 credit 材料構造評価学 Elective Required Prof. Kazumasa Sugiyama, Kenji Tsuda The course is divided into four major parts, each with the following keywords: symmetry, diffraction intensity, crystal structure analysis, and advanced quantum beam applications. Part 1: The hierarchy of crystals is studied, with symmetry of crystal structures as an important key word. Part 2: Understanding the phenomenon of X-ray interference from periodic atomic arrangements, the effects of factors such as the Bravais lattice, atomic arrangement in the unit cell, and the observed diffraction patterns are studied in terms of the reciprocal lattice, structure factor, and shape factor. Part 3: Topics related to the discussion of data obtained from single crystal structure analysis. Part 4: In the field of materials science, analysis using synchrotron radiation sources is widely used. There are several courses in our academic program, but we will focus on synchrotron radiation X-rays and study the state-of-the-art of this field	**Physics of Electrons in Solids** 2 credits 固体電子論 Elective Required Prof. Rie Umetsu, Makoto Kohda Associate Prof. Norihiko Okamoto In order to elucidate and control various functionalities used in recent materials, it is essential to develop a crystallographic background and to understand the behavior of electrons, phonons, and photons in solids and the fundamentals of solid-state physics. The following topics will be lectured on the subjects of electron transport properties such as electrical and thermal conduction, electrical and optical effects. (1) Symmetry operation, (2) point and space groups, (3) group theory, (4) physical property tensors, (5) free electron model, (6) electron transport properties, (7) energy bands, (8) electronic states of solids, (9) phonon dispersion relations I, (10) phonon dispersion relations II, (11) specific heat by optical and acoustic phonons, (12) quantization of phonon energy, (13) thermal expansion and heat conduction based on anharmonic terms, (14) reserve
Materials Theory 1credit 理論材料学 Elective Required Prof. Yu Kumagai, Associate Prof. Shota Ono First-principles calculations, which predict the properties of materials based on quantum mechanics, are an essential tool in the materials research. In this lecture, we will learn about the foundations of first-principles alculations and its application in material design. Additionally, we will study the latest research in materials informatics.	**Crystal Physics and Engineering** 1 credit 結晶物理工学 Elective Required Prof. Hitoshi Takamura, Hisanori Yamane, Akira Yoshikawa, Takahiko Terada Physical properties of functional materials, such as electrical and optical properties, are described by the symmetry of crystal structure and its local arrangement. This course delivers lectures on tensor representations of physical properties for crystalline materials and provides deep insights into their electrical and optical properties.
Iron and Steelmaking Process 1 credit 鉄鋼プロセス学 Elective Required Prof. Hiroshi Nogami, Shigeru Ueda, Hiroyuki Shibata The steel making process, which is the basic material supporting all industries, consists of blast furnace process for reducing iron ore, steelmaking for refining molten iron, and continuous casting for solidifying molten steel, and the process is efficiently mass-produced by precise sophisticated process control. In this lecture, the fundamentals of thermodynamics, reaction rate, transfer rate, solidification, etc., which have been studied up to now, are applied to the phenomena occurring in each process, and analytical methods to control them are introduced. Specifically, numerical analysis model of blast furnace based on heat and mass transfer considering solid/liquid/gas, control method of slag/metal reaction by competitive reaction model which can analyze simultaneous oxidation and reduction of various elements, outline of continuous casting process and analysis of initial solidification phenomenon considering solidification, heat transfer and flow, etc. will be lectured.	**Noufirrous Extractive Metallurgy** 1 credit 非鉄金属プロセス学 Elective Required Prof. Hongmin Zhu, Associate Prof. Osamu Takeda Non-ferrous metals are smelted utilizing physicochemical properties of the metals and their compounds. Operation temperatures are from a room temperature to over 2000 °C; phases involved for reaction are solid, liquid, gas, and their mixtures; reaction media are aqueous solutions, molten salts, and molten slags; reduction methods are thermochemical reduction using carbon, hydrogen, and reactive metal reductants and electrolytic reduction. Fundamental principles and characteristics of smelting processes are reviewed through potential-pH diagram and chemical potential diagram, and current progress of smelting technologies are introduced.
Advanced Structual Materials 2 credits 応用構造材料学 Elective Required Prof. Tadasshi Furuhara, Naoya Masahashi Associate Prof. Goro Miyamoto, Satoshi Semboshi, Kenta Yamanaka The purpose of this lecture is to understand the fundamental principles of microstructure controls in various metallic materials for structure parts, such as steels or non-ferrous metals and alloys. Fundamental microstructure changes such as phase transformations/precipitation or deformation/recrystallization, effects of alloying, or roles of thermomechanical processing are reviewed. Also, relationships between mechanical properties and microstructures are briefly summarized.	**Advanced Casting Technology** 1 credit 応用鋳造工学 Elective Required Prof. Hidemi Kato, Kozo Fujiwara, Associate Prof. Kenta Yamanaka, Junpei Okada This class summarizes the thermodynamics of solidification and its application to microstructural control in practical materials. Specifically, we firstly discuss the microstructural control of silicon for high efficiency solar cells and then the amorphization of this silicon during rapid solidification will be discussed based on the latest research results. In metals, after learning about amorphous alloys and metallic glasses obtained by rapid solidification of eutectic alloys, we will learn about the characteristics of solidification and its microstructure control in Additive Manufacturing and Liquid Metal Dealloying, which are focus on as new material processes.

Advanced Corrosion Engineering 1 credit
応用腐食防食学
Elective Required
Prof.: Izumi Muto, Associate Prof. Yu Sugawara

The purpose of this course is to understand the theory of metallic corrosion. This course is arranged into two parts. The first part deals with the fundamentals of electrochemical aspects of corrosion phenomena and corrosion kinetics. In the second part, corrosion-resistant alloys and corrosion monitoring are described.

Advanced Plastic Forming 1 credit
応用塑性加工学
Elective Required
Prof. Katsunari Oikawa

Many parts of industrial products are made by processing and forming materials. Most of the forming of these parts is conducted by processing using plastic deformation (plastic forming). Plastic forming as a giving shape technique differs from other methods such as cutting and shearing in that it requires less processing time and causes less loss of material. To understand plastic deformation, it is necessary to understand the concepts and methods of mechanics of plasticity. In this course, principles of mechanics of plasticity will be lectured, and the analysis of typical plastic working for metals will be lectured.

Applied Powder Processing and Powder Metallurgy 1 credit
応用粉体加工学
Elective Required
Prof. Naoyuki Nomura, Associate Prof. Zhou WeiWei

Lectures will be given on the basics of additive manufacturing (AM) and its surrounding processes. The feature of AM and its current situation will be introduced. Fabrication process, evaluation method, and safety of powders used for AM process will be lectured.

Lectures will be given on the following items.
1. Introduction of AM
2. Basics of AM and its surrounding process
3. Fabrication process, evaluation method, and safety of powders for AM
4. Application and recent study on AM

Advanced Welding and Joining Engineering 1 credit
応用接合工学
Elective Required
Prof. Yutaka Sato
Details of principles, phenomena and mechanisms of advanced welding and joining processes, and the knowledge to control quality, properties and microstructure of the welded materials and welded interfaces during processes, based on chemical and physical metallurgy, and materials science, will be given. The course is concerned with technically and economically feasible solutions to problems in advanced welding and joining processes.

Numerical Methods for Materials Processing 2 credits
数値材料プロセス学
Elective Required
Prof. Hiroshi Nogami, Associate Prof. Shungo Natsui

A wide variety of materials and formed materials are used in industrial products. In order to secure the cost and quality required for raw materials and fabricated materials, it is important to optimize parameters in material process. Physical phenomena in the material processing are often unsteady and nonlinear, and numerical analysis techniques are essential for optimizing process parameters. It is important to fully understand the principles of the numerical analysis model used, and at the same time to be aware of the model's limitations. In this lecture, students will learn the fundamentals of numerical analysis technique and its application to material processing.

Mechanics of Elasticity and Plasticity 1 credit
弾塑性力学
Elective Required
Prof. Fumio Narita

The primary objectives of this lecture are: (1) to develop a thorough understanding of the relations between the stresses (loads) applied to a structure under various environments and the resulting strains (deformations) of the structure; and (2) to develop adequate numerical procedures for finding the required materials and structures to carry a given load under a severe environment. The principles used to meet the design requirements of the materials and structures are included.

Computational Materials Science 1 credit
計算材料学
Elective Required
Prof. Momoji Kubo,
Associate Prof. Rodion Belosludov, Yusuke Ootani Specially Appointed Associate Prof. Yayoi Terada,

Materials functions and properties are multi-scale phenomena and have extremely strong non-linearity because micro-scale information such as electron behaviors and atomic arrangements affects macro-scale functions and properties through the group dynamics of atoms on meso-scale.Therefore, understanding of the scientific principle on the behaviors of principal elements in each scale is significantly important. In this lecture, basic concepts of Hartree-Fock, Post-Hartree-Fock, and DFT methods are given for understanding the behaviors of electrons and atoms on micro- scale. In addition, basic concepts of molecular dynamics and Ginzburg- Landau methods are given for understanding the group dynamics of atoms on meso-scale. Furthermore, basic concepts of deep learning are given for understanding material informatics technologies that have been attracted recently.

Energy Conversion and Functional Materials 1 credit
エネルギー変換・機能材料学
Elective Required
Prof. Hitoshi Takamura, Hiroshi Masumoto

Functional materials for energy conversion have been attracting much attention. This course delivers the fundamentals and applications of such functional materials: 1) materials for fuel cells and secondary batteries, 2) materials design for energy carrier production such as hydrogen, and 3) piezoelectric and thermoelectric materials.

Magnetic Device Materials 2 credits
磁気デバイス材料学
Elective Required
Prof.Takeshi Seki, Associate Prof. Nobuki Tezuka,
Lecturer. Masashi Matsuura
Adjunct Instructor Seiji Mitani

Magnetic materials have been developed using magnetic properties of various materials. Recently, spintronics is one of the attractive research areas, which is related to various kinds of magnetoresistance effects such as the giant magnetoresistance (GMR) effect and the tunnel magnetoresistance (TMR) effect. This course is dedicated to understand the basis of soft magnetic and hard magnetic materials and recent topics on nanomagnetic structures. In addition, the recent development of spintronics and its applications will be also presented.

Materials Science of Electronic and Optoelectronic Devices
応用電子材料学 1 credit
Elective Required
Prof. Akira Yoshikawa, Associate Prof. Yuichi Kozawa

The physical properties, crystal growth technology and emerging functions and applications of electronic materials that realize semiconductor devices, lasers, and scintillation detectors will be lectured focusing on the following topics.
1. Material Issues of Semiconductor Devices
2. Ultra-fast and High-frequency Semiconductor Electronic and Photonic Devices
3. Crystal Growth and Semiconductor Device Epitaxy & Device Grade Evaluation of Semiconductor Crystals
4. Operation principle and fundamentals of laser
5. Laser Applications
6. High Temperature Bulk Crystal Growth
7. Applications for Scintillation Devices

Nonequilibrium Materials 1 credit

非平衡物質工学

Elective Required

Prof. Hidemi Kato, Junji Saida, Tetsu Ichitsubo, Associate Prof. Takeshi Wada

In this lecture we will learn synthesis, structure, mechanical, physical and chemical properties of materials with novel structure. They are amorphous and quasi-crystalline materials without long-range periodicity in atomic arrangement and nanocystalline materials containing high volume fraction of grain boundary. Non-equilibrium processes for synthesizing such novel materials, including rapid solidification, vapor condensation, solid state reaction and slow solidification, will be explained. Fundamental properties of bulk metallic glasses(BMGs) including high strength, toughness and superplasticity by Newtonian viscous flow, will lectured. The application of BMGs for advanced functional materials for soft magnetism, magnetic permeability, permanent magnet, magnetostriction, corrosion resistance, fuel cell and catalyst will be introduced.

Advanced Materials Characterization 1 credit

先端材料評価学

Elective Required

Prof. Kenji Tsuda, Kazumasa Sugiyama

Based on the basics learned in the lecture Structural Characterization of Materials, advanced materials characterization methods using electron microscopy and electron diffraction are explained. The following items are described: Electron diffraction theory, Symmetry determination and local crystal structure analysis by Convergent-Beam Electron Diffraction, Diffraction contrast and phase contrast of Transmission Electron Microscopy images, Electromagnetic field analysis by Electron Holography, Compositional and electronic state analysis by Scanning Transmission Electron Microscopy and Analytical Electron Microscopy.

Evaluation of Materials 1 credit

材料計測学

Elective Required

Prof. Atsushi Momose, Yoshikazu Ohara

Focusing mainly on methods using X-rays and ultrasonic waves for the methods of measurements and evaluations needed for sophisticated and safe uses of metals, piezoelectric materials, nano materials, polymers, composite materials, and devices and structural elements composed by them, their principle and application technology are described.
We deepen the understanding on X-ray diffraction/scattering/spectroscopy/imaging and ultrasonic wave propagation and its applications for measurements.

Biomaterials Science 1 credit

生体材料学

Elective Required

Prof. Takayuki Narushima, Masaya Yamamoto Associate Prof. Kyosuke Ueda

In the super-aging society, expectations for biomaterials are high and various functions are required. This course covers the design, physical, mechanical, chemical, and biological properties of metallic, ceramic, and polymeric biomaterials used for biofunctional reconstruction, therapy, and diagnosis. In addition, their biological reactions with hard and soft tissues and evaluation methods are lectured. The purpose of this course is to deepen understanding of the fundamental characteristics of biomaterials.

Soft Materials 1 credit

ソフトマテリアル

Elective Required

Prof. Masaya Yamamoto

Soft materials include liquids, polymers, gels, colloidal particles, liquid crystals, and many biological materials. A common feature of these soft materials is that the constituent molecules form mesoscopic structures due to intermolecular forces. As a result, they exhibit scale-dependent softness and slow dynamics. This lecture will introduce the thermodynamics and dynamics characteristics of soft materials. Examples of their applications will also be outlined.

Nanostructures and Function Control in Materials 2 credits

ナノ構造制御機能発現工学

Elective Required

Prof. Yuji Sutou, Makoto Kohda, Mikihiko Ogane, Takeshi Seki

In current materials science, to develop new functional materials, we have to control the crystal structure and microstructure of materials at nanoscale. In this lecture, the basics of physics and materials science related to the microstructure and device structure control at nanoscale will be explained, and new functions (mainly electromagnetic functions) that emerge based on various nanostructures will be introduced and discussed. We will also discuss how these functions are applied to devices beyond the traditional framework of metals and semiconductors.

Functional Optical Materials 1credit

光機能材料特論

Elective Required

Prof. Chao-nan Xu, Adjunct Instructor

This lecture covers the fundamentals and applications of photonic materials and discusses future outlook. The objective is to comprehensively understand natural and artificial photonic materials, starting from an overview and encompassing the basics, manufacturing processes, characteristics, applications, and recent developments in representative optical materials.

Advanced Steel Engineering 2 credits

先進鉄鋼工学

Elective Required

Prof. Takahiro Miki,

Specially Appointed Prof. Yuji Miki, Ichikawa Kazutoshi

Visiting Prof. Masafumi Miyazaki

Iron/steel is the most used material on the earth, and steels are manufactured by controlled large-scale processing, whose microstructure was analyzed and controlled at the atomic scale. In this course, the students will learn the basic aspects of the state-of-the-art technology related to steel, based on materials science and processing, and the connection and applied skill to fundamental sciences. The lecture consists of the steel making processing, environmental issues of steel making, control of microstructure and surface of steel products, and latest evaluation techniques including computational science for steels.

Non-errousMetallurgicalandEnvironmentalScienceandEngineering

非鉄金属製錬環境科学特論 1credit

Elective Required

Prof. Hiroyuki Shibata, Takahisa Omata, Hiroyuki Fukuyama, Atsushi Muramatsu

Part-time Lecturer to be announced

Non-ferrous materials such as copper and nickel are essential in a highly developed modern society. On the other hand, the resources available are limited, and the requirements for high-level resource processing and smelting technology are always high. An integrated understanding of non-ferrous resources to materials and recycling leads to an understanding of the arteries and veins of industry. University faculty members give lectures on the basics related to the smelting of materials, and corporate lecturers share the actual industrial process with lecturers.

Internship Training 1～2 credits

インターンシップ研修

Elective Required

Practical training and research activities will be conducted at companies as hands-on exercises for about 2 weeks to 1 month.

Special Lectures on Material Science and Engineering
材料科学工学特別講義
Elective Required

These special lectures are designed to introduce important academic and research fields in specialized fields and related fields, and to promote professional knowledge and the creative development of scholarship related to research for Master's Thesis.

Special Seminar on Material Science and Engineering
材料科学工学特別研修
Elective Required

Acquire problem-solving ability by integrating advanced specialized knowledge through seminars and exercises inside and outside the university for important academic and research fields in specialized fields and related fields.

Seminar on Metallurgical Process Engineering 4 credits
金属プロセス工学セミナー
Elective Required
Prof. Takahiro Miki

Targeting the latest domestic and foreign researcheses related to master's thesis research in Metallurgical Process Engineering, students will learn the research and introduction methods, and conduct discussions and exercises based on them.

Seminar on Materials Forming and Structural Control
創形創質プロセス学セミナー 4 credits
Elective Required
Prof. Ryosuke Kainuma, Toshihiro Ohmori, Katsunari Oikawa

Targeting the latest domestic and foreign researches related to master's thesis research in the Materials Formig and Structural Control Studies Group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.

Seminar on Advanced Materials Physical Chemistry 4 credits
先端マテリアル物理化学セミナー
Elective Required
Prof. Hongmin Zhu, Yoshitaka Kasukabe,
Associate Prof. Osamu Takeda

Targeting the latest domestic and foreign researches related to the master's thesis research in the Advanced Materials Physical Chemistry Group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.

Seminar on Material Processing Design 4 credits
プロセス設計学セミナー
Elective Required
Prof. Hiroyuki Shibata, Shigeru Ueda,
Associate Prof. Sohei Sukenaga

Targeting the latest domestic and foreign researches related to master's thesis research in the Material Proessing Design Group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.

Seminar on Materials Processing Control 4 credits
プロセス制御学セミナー
Elective Required
Prof. Tadashi Furuhara, Tetsu Ichitsubo, Hiroshi Nogami,
Yukio Takahashi, Associate Prof. Goro Miyamoto, Norihiko Okamoto,
Shungo Natsui, Kozo Shinoda

Targeting the latest domestic and foreign researches related to master's thesis research in the Process Control for Materials Processing group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.

Research for Master's Thesis in Metallurgy 6 credits
金属フロンティア工学修士研修
Elective Required
All Professors

Belonging to each group of metallurgical process engineering, materials forming and structural control, advanced material physical chemistry, Processing Design （IMRAM）, and Process Control for materials processing （IMR）, students will conduct research, presentation, discussion, and literature introductions.

授業科目表（MC）Opening of a course class subject list

Department of Materials Science

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	製錬・精製の熱力学 Thermodynamics of Smelting & Refining	every year	JE		2		
	製錬・精製の速度論 Reaction Kinetics in Metallurgical Processes	every year	JE		1		
	材料表面界面科学 Science of Surfaces and Interfaces in Materials	every year	JE		2		
	相変態論 Theory of Phase Transformations	every year	J&E		2		
	量子化学 Quantum Chemistry	every year	J		1		
	材料電気化学 Materials Electrochemistry	every year	JE		2		
	疲労と破壊の材料学 Fatigue Strength and Fracture of Materials	every year	E		2		
	格子欠陥論 Lattice Defects Theory	every year	E		2		
	材料構造評価学 Structural Characterization of Materials	every year	JE		1		
	固体電子論 Physics of Electrons in Solids	every year	JE		2		
	理論材料学 Materials Theory	every year	E		1		
専門科目 Major General Subjects	結晶物理工学 Crystal Physics and Engineering	every year	JE		1		
	鉄鋼プロセス学 Iron and Steelmaking Process	every year	JE		1		
	非鉄金属プロセス学 Noufirrous Extractive Metallurgy	every year	JE		1		
	応用構造材料学 Advanced Structual Materials	every year	JE		2		
	応用鋳造工学 Advanced Casting Technology	every year	JE		1		
	応用腐食防食学 Advanced Corrosion Engineering	every year	JE		1		
	応用塑性加工学 Advanced Plastic Forming	every year	J		1		
	応用粉体加工学 Applied Powder Processing and Powder Metallurgy	every year	E		1		
	応用接合工学 Advanced Welding and Joining Engineering	every year	JE		1		
	数値材料プロセス学 Numerical Methods for Materials Processing	every year	JE		2		
	弾塑性力学 Mechanics of Elasticity and Plasticity	every year	JE		1		
	計算材料学 Computational Materials Science	every year	JE		1		

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	選択必須 Elective Required	選択 Elective	備考 Remarks
専門科目 Major General Subjects	エネルギー変換・機能材料学 Energy Conversion and Functional Materials	every year	E		1		
	磁気デバイス材料学 Magnetic Device Materials	every year	JE		2		
	応用電子材料学 Materials Science of Electronic and Optoelectronic Devices	every year	JE		1		
	非平衡物質工学 Nonequilibrium Materials	every year	JE		1		
	先端材料評価学 Advanced Materials Characterization	every year	JE		1		
	材料計測学 Evaluation of Materials	every year	E		1		
	生体材料学 Biomaterials Science	every year	E		1		
	ソフトマテリアル Soft Materials	every year	E		1		
	ナノ構造制御機能発現工学 Nanostructures and Function Control in Materials	every year	E		2		
	光機能材料概論 Functional Optical Materials	every year	E		1		
	先進鉄鋼工学 Advanced Steel Engineering	every year	J		2		
	非金属製錬環境科学特論 Non-ferrous Metallurgical and Environmental Science and Engineering	every year	J		1		
	インターンシップ研修 Internship training				1〜2		
	材料科学工学特別講義 Special Lectures on Material Science and Engineering						
	材料科学工学特別研修 Special Seminar on Material Science and Engineering						
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	材料電子化学セミナー Seminar on Materials Electrochemistry						
	ナノ材料物性学セミナー Seminar on Nano-materials Science						
	情報デバイス材料学セミナー Seminar on Materials and Devices for Information Technology						
	ナノ構造物質工学セミナー Seminar on Nano-Structured Materials						
	物質機能創製学セミナー Seminar on Materials Function and Synthesis						
	知能デバイス材料学修士研修 Research for Master's Thesis in Materials Science						

1，上記科目の単位数を合わせて 30 単位以上を修得すること。

Students must acquire 30 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Class Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Thermodynamics of Smelting & Refining 2 credits
製錬・精製の熱力学
Elective Required
Prof. Hiroyuki Shibata, Hongmin Zhu, Shigeru Ueda, Takahiro Miki
Associate Prof. Sohei Sukenaga

The goal of this lecture is to apply the basic knowledge already learned about chemical thermodynamics necessary for the production of metal materials and the creation of new materials of steel and non-ferrous metals to actual smelting and refining processes, and to improve it to a level where they can be analyzed using thermodynamics. In the first half, as the basis for analyzing the material manufacturing process, multicomponent phase equilibrium, reaction path and phase analysis, electrochemistry, potential diagrams, thermodynamics, structure, physical properties (measurement method), solution model, etc. of melts and solutions are explained, and in the second half, steel smelting (iron and steelmaking) and non-ferrous metal smelting (base metals such as copper, zinc, lead, and rare metals) processes, Deepen understanding by introducing examples and exercises on analysis methods using chemical thermodynamics.

Reaction Kinetics in Metallurgical Processes 1 credit
製錬・精製の速度論
Elective Required
Prof. Hiroshi Nogami, Associate Prof. Shungo Natsui

The fundamental concepts of material processes are designed based on thermodynamics. It is necessary to evaluate and/or estimate the rate-determining process quantitatively for their actual process designs. In this course, the students will learn about the several kinetic processes that are taken out from the actual smelting and refining processes. In this lecture, we will introduce how the reaction kinetics and transport kinetics that we have learned so far are applied to the analysis of the phenomena that occur in the actual refining process. Specific topics will be type of reactor, mass balance, and kinetic analysis of gas-solid/gas-liquid heterogeneous reactions.

Science of Surfaces and Interfaces in Materials 2 credits
材料表面界面科学
Elective Required
Prof. Naoya Masahashi, Yoshitaka Kasukabe, Tomomasa Wadayama,
Associate Prof. Kozo Shinoda

While the property of solid material originated from a volumetric property covering the whole solid, the atomic coordination is unsaturated on the surface of the solid, and the atomic arrangement is disturbed at the interface in the solid. Since these disordered atomic arrangements have a great influence on the physical properties of surfaces and interfaces, they form a discipline called surface and surface science. The purpose of this lecture is to understand various surface and interface phenomena in industrially important processes from the standpoint of basic physical properties. Specifically, in the first half, lectures will be given on the atomic arrangement of solid surfaces, thermodynamics and chemical bonds between surfaces and interfaces, and surface functions. In the second half, lectures will be given on analytical methods using ions for evaluating solid surfaces and thin film growth.

Theory of Phase Transformations 2 credits
相変態論
Elective Required
Prof. Ryosuke Kainuma, Yuji Sutou, Tetsu Ichitsubo, Toshihiro Ohmori

The purpose of the course is to make the participants understand the basic issues on phase transformations in materials on the basis of thermodynamics of microstructures. The main contents are ①phase diagrams and free energy (regular solution and sub-lattice models and phase equilibrium), ② thermodynamics on phase interface (grain boundary segregation and grain growth), ③diffusion phenomena (Fick's laws and phenomenological diffusion equation), ④thermodynamics on nucleation, ⑤martensitic transformations (crystallographic phenomenological theory and transformation hysteresis and interval) and ⑥thermodynamics on microstructural change (JMAK equation and eutectic and eutectoid transformations).

Quantum Chemistry 1 credit
量子化学
Elective Required
Prof. Momoji Kubo, Associate Prof. Yusuke Ootani
Specially Appointed Associate Prof. Yayoi Terada

Most functions and properties of materials can be understood from the behaviors of atoms and electrons in materials. Conversely, understanding the behaviors of atoms and electrons realizes the theoretical design of the materials with high performance and functions. Here, understanding the behavior of electrons requires knowledge on the concept and method of quantum chemistry. Basics of quantum chemistry is Schrödinger equation and molecular orbital theory has grown and advanced on the basis of the Schrödinger equation. Solving electronic states of materials by molecular orbital theory and computer realizes the understanding and predicting of the functions and properties of materials. In this class, 1) atomic orbital and molecular orbital, 2) molecular orbital theory, 3) Hückel theory, and 4) band theory of solids are given for understanding the basics of the quantum chemistry. Textbook: Atkins Physical Chemistry (1), Tokyo Kagaku Doujin.

Materials Electrochemistry 2 credits
材料電気化学
Elective Required
Prof. Izumi Muto, Hongmin Zhu,
Associate Prof. Osamu Takeda, Yu Sugawara

The purpose of this course is to understand the theory and practical application of electrochemistry in materials science. This course is arranged into three parts. The first part deals with fundamentals of electrochemical equilibrium and reaction kinetics on metal electrodes in terms of electron transfer. In the second part, the method of electrochemical measurements is described. Third part covers characteristics of industrial electrolysis (chlor-alkali process, electrowinning of zinc, electrowinning of aluminum) and key points for establishing industrial electrolysis.

Fatigue Strength and Fracture of Materials 2 credits
疲労と破壊の材料学
Elective Required
Prof. Naoyuki Nomura, Kyosuke Yoshimi, Yoshikazu Ohara

The lecture will cover fatigue phenomena and fatigue strength of materials, fracture mechanics and fracture toughness, and the basics of fatigue crack initiation and propagation mechanisms, from the viewpoint of not only understanding microscopic phenomena of materials, but also how macroscopic deformation and fracture of materials are correlated with microscopic phenomena. The course will explain how these concepts can be applied to materials engineering and how macroscopic fracture mechanics parameters can be utilized to ensure the safety and reliability of structures.

Lattice Defects Theory 2 credits
格子欠陥論
Elective Required
Prof. Kyosuke Yoshimi, Associate Prof. Nobuaki Sekido

Material properties strongly depend on the type and concentration of lattice defects in the material. Lattice defects are always introduced in a certain amount by synthesis or processing, and their type and concentration change depending on the operating environment. Therefore, knowledge and understanding of the types and concentrations of lattice defects and their measurement methods are essential for material design to exploit the excellent properties of materials fully and to maintain stable properties over the long term. In this lecture, the structure and physical properties of point defects, line defects (dislocations), and plane defects in materials will be outlined, and the behavior of these lattice defects in materials and their effects on material properties will be introduced. Furthermore, examples where lattice defects play a vitally important role from a practical standpoint, such as irradiation damage, and methods for measuring lattice defect concentration will also be presented.

Structural Characterization of Materials 1 credit
材料構造評価学
Elective Required
Prof. Kazumasa Sugiyama, Kenji Tsuda

The course is divided into four major parts, each with the following keywords:
symmetry, diffraction intensity, crystal structure analysis, and advanced quantum beam applications.
Part 1: The hierarchy of crystals is studied, with symmetry of crystal structures as an important key word.
Part 2: Understanding the phenomenon of X-ray interference from periodic atomic arrangements, the effects of factors such as the Bravais lattice, atomic arrangement in the unit cell, and the observed diffraction patterns are studied in terms of the reciprocal lattice, structure factor, and shape factor.
Part 3: Topics related to the discussion of data obtained from single crystal structure analysis.
Part 4: In the field of materials science, analysis using synchrotron radiation sources is widely used. There are several courses in our academic program, but we will focus on synchrotron radiation X-rays and study the state-of-the-art of this field

Physics of Electrons in Solids 2 credits
固体電子論
Elective Required
Prof. Rie Umetsu, Makoto Kohda
Associate Prof. Norihiko Okamoto

In order to elucidate and control various functionalities used in recent materials, it is essential to develop a crystallographic background and to understand the behavior of electrons, phonons, and photons in solids and the fundamentals of solid-state physics. The following topics will be lectured on the subjects of electron transport properties such as electrical and thermal conduction, electrical and optical effects. (1) Symmetry operation, (2) point and space groups, (3) group theory, (4) physical property tensors, (5) free electron model, (6) electron transport properties, (7) energy bands, (8) electronic states of solids, (9) phonon dispersion relations I, (10) phonon dispersion relations II, (11) specific heat by optical and acoustic phonons, (12) quantization of phonon energy, (13) thermal expansion and heat conduction based on anharmonic terms, (14) reserve

Materials Theory 1credit
理論材料学
Elective Required
Prof. Yu Kumagai, Associate Prof. Shota Ono

First-principles calculations, which predict the properties of materials based on quantum mechanics, are an essential tool in the materials research.
In this lecture, we will learn about the foundations of first-principles alculations and its application in material design.
Additionally, we will study the latest research in materials informatics.

Crystal Physics and Engineering 1 credit
結晶物理工学
Elective Required
Prof. Hitoshi Takamura, Hisanori Yamane, Akira Yoshikawa, Takahiko Terada

Physical properties of functional materials, such as electrical and optical properties, are described by the symmetry of crystal structure and its local arrangement. This course delivers lectures on tensor representations of physical properties for crystalline materials and provides deep insights into their electrical and optical properties.

Iron and Steelmaking Process 1 credit
鉄鋼プロセス学
Elective Required
Prof. Hiroshi Nogami, Shigeru Ueda, Hiroyuki Shibata

The steel making process, which is the basic material supporting all industries, consists of blast furnace process for reducing iron ore, steelmaking for refining molten iron, and continuous casting for solidifying molten steel, and the process is efficiently mass-produced by precise sophisticated process control. In this lecture, the fundamentals of thermodynamics, reaction rate, transfer rate, solidification, etc., which have been studied up to now, are applied to the phenomena occurring in each process, and analytical methods to control them are introduced. Specifically, numerical analysis model of blast furnace based on heat and mass transfer considering solid/liquid/gas, control method of slag/metal reaction by competitive reaction model which can analyze simultaneous oxidation and reduction of various elements, outline of continuous casting process and analysis of initial solidification phenomenon considering solidification, heat transfer and flow, etc. will be lectured.

Noufirrous Extractive Metallurgy 1 credit
非鉄金属プロセス学
Elective Required
Prof. Hongmin Zhu, Associate Prof. Osamu Takeda

Non-ferrous metals are smelted utilizing physicochemical properties of the metals and their compounds. Operation temperatures are from a room temperature to over 2000 °C; phases involved for reaction are solid, liquid, gas, and their mixtures; reaction media are aqueous solutions, molten salts, and molten slags; reduction methods are thermochemical reduction using carbon, hydrogen, and reactive metal reductants and electrolytic reduction. Fundamental principles and characteristics of smelting processes are reviewed through potential-pH diagram and chemical potential diagram, and current progress of smelting technologies are introduced.

Advanced Structual Materials 2 credits
応用構造材料学
Elective Required
Prof. Tadasshi Furuhara, Naoya Masahashi
Associate Prof. Goro Miyamoto, Satoshi Semboshi, Kenta Yamanaka

The purpose of this lecture is to understand the fundamental principles of microstructure controls in various metallic materials for structure parts, such as steels or non-ferrous metals and alloys. Fundamental microstructure changes such as phase transformations/precipitation or deformation/recrystallization, effects of alloying, or roles of thermomechanical processing are reviewed. Also, relationships between mechanical properties and microstructures are briefly summarized.

Advanced Casting Technology 1 credit
応用鋳造工学
Elective Required
Prof. Hidemi Kato, Kozo Fujiwara,
Associate Prof. Kenta Yamanaka, Junpei Okada

This class summarizes the thermodynamics of solidification and its application to microstructural control in practical materials. Specifically, we firstly discuss the microstructural control of silicon for high efficiency solar cells and then the amorphization of this silicon during rapid solidification will be discussed based on the latest research results. In metals, after learning about amorphous alloys and metallic glasses obtained by rapid solidification of eutectic alloys, we will learn about the characteristics of solidification and its microstructure control in Additive Manufacturing and Liquid Metal Dealloying, which are focus on as new material processes.

Advanced Corrosion Engineering 1 credit
応用腐食防食学
Elective Required
Prof.: Izumi Muto, Associate Prof. Yu Sugawara

The purpose of this course is to understand the theory of metallic corrosion. This course is arranged into two parts. The first part deals with the fundamentals of electrochemical aspects of corrosion phenomena and corrosion kinetics. In the second part, corrosion-resistant alloys and corrosion monitoring are described.

Advanced Plastic Forming 1 credit
応用塑性加工学
Elective Required
Prof. Katsunari Oikawa

Many parts of industrial products are made by processing and forming materials. Most of the forming of these parts is conducted by processing using plastic deformation (plastic forming). Plastic forming as a giving shape technique differs from other methods such as cutting and shearing in that it requires less processing time and causes less loss of material. To understand plastic deformation, it is necessary to understand the concepts and methods of mechanics of plasticity. In this course, principles of mechanics of plasticity will be lectured, and the analysis of typical plastic working for metals will be lectured.

Applied Powder Processing and Powder Metallurgy 1 credit
応用粉体加工学
Elective Required
Prof. Naoyuki Nomura, Associate Prof. Zhou WeiWei

Lectures will be given on the basics of additive manufacturing (AM) and its surrounding processes. The feature of AM and its current situation will be introduced. Fabrication process, evaluation method, and safety of powders used for AM process will be lectured.

Lectures will be given on the following items.
1. Introduction of AM
2. Basics of AM and its surrounding process
3. Fabrication process, evaluation method, and safety of powders for AM
4. Application and recent study on AM

Advanced Welding and Joining Engineering 1 credit
応用接合工学
Elective Required
Prof. Yutaka Sato
Details of principles, phenomena and mechanisms of advanced welding and joining processes, and the knowledge to control quality, properties and microstructure of the welded materials and welded interfaces during processes, based on chemical and physical metallurgy, and materials science, will be given. The course is concerned with technically and economically feasible solutions to problems in advanced welding and joining processes.

Numerical Methods for Materials Processing 2 credits
数値材料プロセス学
Elective Required
Prof. Hiroshi Nogami, Associate Prof. Shungo Natsui

A wide variety of materials and formed materials are used in industrial products. In order to secure the cost and quality required for raw materials and fabricated materials, it is important to optimize parameters in material process. Physical phenomena in the material processing are often unsteady and nonlinear, and numerical analysis techniques are essential for optimizing process parameters. It is important to fully understand the principles of the numerical analysis model used, and at the same time to be aware of the model's limitations. In this lecture, students will learn the fundamentals of numerical analysis technique and its application to material processing.

Mechanics of Elasticity and Plasticity 1 credit
弾塑性力学
Elective Required
Prof. Fumio Narita

The primary objectives of this lecture are: (1) to develop a thorough understanding of the relations between the stresses (loads) applied to a structure under various environments and the resulting strains (deformations) of the structure; and (2) to develop adequate numerical procedures for finding the required materials and structures to carry a given load under a severe environment. The principles used to meet the design requirements of the materials and structures are included.

Computational Materials Science 1 credit
計算材料学
Elective Required
Prof. Momoji Kubo,
Associate Prof. Rodion Belosludov, Yusuke Ootani Specially Appointed Associate Prof. Yayoi Terada,

Materials functions and properties are multi-scale phenomena and have extremely strong non-linearity because micro-scale information such as electron behaviors and atomic arrangements affects macro-scale functions and properties through the group dynamics of atoms on meso-scale.Therefore, understanding of the scientific principle on the behaviors of principal elements in each scale is significantly important. In this lecture, basic concepts of Hartree-Fock, Post-Hartree-Fock, and DFT methods are given for understanding the behaviors of electrons and atoms on micro- scale. In addition, basic concepts of molecular dynamics and Ginzburg- Landau methods are given for understanding the group dynamics of atoms on meso-scale. Furthermore, basic concepts of deep learning are given for understanding material informatics technologies that have been attracted recently.

Energy Conversion and Functional Materials 1 credit
エネルギー変換・機能材料学
Elective Required
Prof. Hitoshi Takamura, Hiroshi Masumoto

Functional materials for energy conversion have been attracting much attention. This course delivers the fundamentals and applications of such functional materials: 1) materials for fuel cells and secondary batteries, 2) materials design for energy carrier production such as hydrogen, and 3) piezoelectric and thermoelectric materials.

Magnetic Device Materials 2 credits
磁気デバイス材料学
Elective Required
Prof.Takeshi Seki, Associate Prof. Nobuki Tezuka,
Lecturer. Masashi Matsuura
Adjunct Instructor Seiji Mitani

Magnetic materials have been developed using magnetic properties of various materials. Recently, spintronics is one of the attractive research areas, which is related to various kinds of magnetoresistance effects such as the giant magnetoresistance (GMR) effect and the tunnel magnetoresistance (TMR) effect. This course is dedicated to understand the basis of soft magnetic and hard magnetic materials and recent topics on nanomagnetic structures. In addition, the recent development of spintronics and its applications will be also presented.

Materials Science of Electronic and Optoelectronic Devices
応用電子材料学 1 credit
Elective Required
Prof. Akira Yoshikawa, Associate Prof. Yuichi Kozawa

The physical properties, crystal growth technology and emerging functions and applications of electronic materials that realize semiconductor devices, lasers, and scintillation detectors will be lectured focusing on the following topics.
1. Material Issues of Semiconductor Devices
2. Ultra-fast and High-frequency Semiconductor Electronic and Photonic Devices
3. Crystal Growth and Semiconductor Device Epitaxy & Device Grade Evaluation of Semiconductor Crystals
4. Operation principle and fundamentals of laser
5. Laser Applications
6. High Temperature Bulk Crystal Growth
7. Applications for Scintillation Devices

Nonequilibrium Materials 1 credit
非平衡物質工学
Elective Required
Prof. Hidemi Kato, Junji Saida, Tetsu Ichitsubo, Associate Prof. Takeshi Wada

In this lecture we will learn synthesis, structure, mechanical, physical and chemical properties of materials with novel structure. They are amorphous and quasi-crystalline materials without long-range periodicity in atomic arrangement and nanocystalline materials containing high volume fraction of grain boundary. Non-equilibrium processes for synthesizing such novel materials, including rapid solidification, vapor condensation, solid state reaction and slow solidification, will be explained. Fundamental properties of bulk metallic glasses(BMGs) including high strength, toughness and superplasticity by Newtonian viscous flow, will lectured. The application of BMGs for advanced functional materials for soft magnetism, magnetic permeability, permanent magnet, magnetostriction, corrosion resistance, fuel cell and catalyst will be introduced.

Advanced Materials Characterization 1 credit
先端材料評価学
Elective Required
Prof. Kenji Tsuda, Kazumasa Sugiyama

Based on the basics learned in the lecture Structural Characterization of Materials, advanced materials characterization methods using electron microscopy and electron diffraction are explained. The following items are described: Electron diffraction theory, Symmetry determination and local crystal structure analysis by Convergent-Beam Electron Diffraction, Diffraction contrast and phase contrast of Transmission Electron Microscopy images, Electromagnetic field analysis by Electron Holography, Compositional and electronic state analysis by Scanning Transmission Electron Microscopy and Analytical Electron Microscopy.

Evaluation of Materials 1 credit
材料計測学
Elective Required
Prof. Atsushi Momose, Yoshikazu Ohara

Focusing mainly on methods using X-rays and ultrasonic waves for the methods of measurements and evaluations needed for sophisticated and safe uses of metals, piezoelectric materials, nano materials, polymers, composite materials, and devices and structural elements composed by them, their principle and application technology are described.
We deepen the understanding on X-ray diffraction/scattering/spectroscopy/imaging and ultrasonic wave propagation and its applications for measurements.

Biomaterials Science 1 credit
生体材料学
Elective Required
Prof. Takayuki Narushima, Masaya Yamamoto Associate Prof. Kyosuke Ueda

In the super-aging society, expectations for biomaterials are high and various functions are required. This course covers the design, physical, mechanical, chemical, and biological properties of metallic, ceramic, and polymeric biomaterials used for biofunctional reconstruction, therapy, and diagnosis. In addition, their biological reactions with hard and soft tissues and evaluation methods are lectured. The purpose of this course is to deepen understanding of the fundamental characteristics of biomaterials.

Soft Materials 1 credit
ソフトマテリアル
Elective Required
Prof. Masaya Yamamoto

Soft materials include liquids, polymers, gels, colloidal particles, liquid crystals, and many biological materials. A common feature of these soft materials is that the constituent molecules form mesoscopic structures due to intermolecular forces. As a result, they exhibit scale-dependent softness and slow dynamics. This lecture will introduce the thermodynamics and dynamics characteristics of soft materials. Examples of their applications will also be outlined.

Nanostructures and Function Control in Materials 2 credits
ナノ構造制御機能発現工学
Elective Required
Prof. Yuji Sutou, Makoto Kohda, Mikihiko Ogane, Takeshi Seki

In current materials science, to develop new functional materials, we have to control the crystal structure and microstructure of materials at nanoscale. In this lecture, the basics of physics and materials science related to the microstructure and device structure control at nanoscale will be explained, and new functions (mainly electromagnetic functions) that emerge based on various nanostructures will be introduced and discussed. We will also discuss how these functions are applied to devices beyond the traditional framework of metals and semiconductors.

Functional Optical Materials 1credit
光機能材料特論
Elective Required
Prof. Chao-nan Xu, Adjunct Instructor

This lecture covers the fundamentals and applications of photonic materials and discusses future outlook. The objective is to comprehensively understand natural and artificial photonic materials, starting from an overview and encompassing the basics, manufacturing processes, characteristics, applications, and recent developments in representative optical materials.

Advanced Steel Engineering 2 credits
先進鉄鋼工学
Elective Required
Prof. Takahiro Miki,
Specially Appointed Prof. Yuji Miki, Ichikawa Kazutoshi
Visiting Prof. Masafumi Miyazaki

Iron/steel is the most used material on the earth, and steels are manufactured by controlled large-scale processing, whose microstructure was analyzed and controlled at the atomic scale. In this course, the students will learn the basic aspects of the state-of-the-art technology related to steel, based on materials science and processing, and the connection and applied skill to fundamental sciences. The lecture consists of the steel making processing, environmental issues of steel making, control of microstructure and surface of steel products, and latest evaluation techniques including computational science for steels.

Non-errousMetallurgicalandEnvironmentalScienceandEngineering
非鉄金属製錬環境科学特論 1credit
Elective Required
Prof. Hiroyuki Shibata, Takahisa Omata, Hiroyuki Fukuyama, Atsushi Muramatsu
Part-time Lecturer to be announced

Non-ferrous materials such as copper and nickel are essential in a highly developed modern society. On the other hand, the resources available are limited, and the requirements for high-level resource processing and smelting technology are always high. An integrated understanding of non-ferrous resources to materials and recycling leads to an understanding of the arteries and veins of industry. University faculty members give lectures on the basics related to the smelting of materials, and corporate lecturers share the actual industrial process with lecturers.

Internship Training 1～2 credits
インターンシップ研修
Elective Required

Practical training and research activities will be conducted at companies as hands-on exercises for about 2 weeks to 1 month.

Special Lectures on Material Science and Engineering 材料化学工学特別講義 Elective Required These special lectures are designed to introduce important academic and research fields in specialized fields and related fields, and to promote professional knowledge and the creative development of scholarship related to research for Master's Thesis.	**Special Seminar on Material Science and Engineering** 材料化学工学特別研修 Elective Required Acquire problem-solving ability by integrating advanced specialized knowledge through seminars and exercises inside and outside the university for important academic and research fields in specialized fields and related fields.
Seminar on Materials Electrochemistry 4 credits 材料電子化学セミナー Elective Required Prof.: Izumi Muto, Associate Prof. Yu Sugawara Targeting the latest domestic and foreign researches related to master's thesis research in materials electrochemistry, students will learn the research and introduction methods, and conduct discussions and exercises based on them.	**Seminar on Nano-Structured Materials** 4 credits ナノ材料物性学セミナー Elective Required Prof. Yuji Sutou, Kyosuke Yoshimi Associate Prof. Sekido Nobuaki, Daisuke Ando Targeting the latest domestic and foreign researcheses related to the master's thesis research in the Nanomaterials Condensed Matter Physics Group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.
Seminar on Materials and Devices for Information Technology 情報デバイス材料学セミナー 4credits Elective Required Prof. Makoto Kohda, Hitoshi Takamura Associate Prof. Nobuki Tezuka, Lecturer. Masashi Matsuura Targeting the latest domestic and foreign researches related to master's thesis research in the materials and devices for information technology group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.	**Seminar on Nano-Structured Materials** 4 credits ナノ構造物質工学セミナー Elective Required Prof. Kazumasa Sugiyama, Hidemi Kato, Momoji Kubo, Junji SaidaAssociate Prof. Takeshi Wada, Yusuke Ootani, Yayoi Terada, Rodion Belosludov Targeting the latest domestic and foreign researches related to master's thesis research in the Nanostructure Materials Engineering Group, students will acquire the research and introduction methods, and conduct discussions and exercises basedon them.
Seminar on Materials Function and Synthesis 4 credits 物質機能創製学セミナー Elective Required Prof. Atsushi Momose, Yuta Saito Associate Prof. Yoshichika Seki Targeting the latest domestic and foreign researches related to master's thesis research in the materials function and syntheaia group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.	**Research for Master's Thesis in Materials Science** 6 credits 知能デバイス材料学修士研修 Elective Required All Professors Belonging to each group of material electronic chemistry, nanomaterials condensed matter physics, information device materials science, nanostructure material engineering, material function creation science, material surface function control science, experiments and exercises such as research, research presentation, discussion, literature introduction, etc. We do.

授業科目表（MC）Opening of a course class subject list

Department of Materials Processing

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	製錬・精製の熱力学 Thermodynamics of Smelting & Refining	every year	JE		2		
	製錬・精製の速度論 Reaction Kinetics in Metallurgical Processes	every year	JE		1		
	材料表面界面科学 Science of Surfaces and Interfaces in Materials	every year	JE		2		
	相変態論 Theory of Phase Transformations	every year	J&E		2		
	量子化学 Quantum Chemistry	every year	J		1		
	材料電気化学 Materials Electrochemistry	every year	JE		2		
	疲労と破壊の材料学 Fatigue Strength and Fracture of Materials	every year	E		2		
	格子欠陥論 Lattice Defects Theory	every year	E		2		
	材料構造評価学 Structural Characterization of Materials	every year	JE		1		
	固体電子論 Physics of Electrons in Solids	every year	JE		2		
	理論材料学 Materials Theory	every year	E		1		
専門科目 Major General Subjects	結晶物理工学 Crystal Physics and Engineering	every year	JE		1		
	鉄鋼プロセス学 Iron and Steelmaking Process	every year	JE		1		
	非鉄金属プロセス学 Noufirrous Extractive Metallurgy	every year	JE		1		
	応用構造材料学 Advanced Structual Materials	every year	JE		2		
	応用鋳造工学 Advanced Casting Technology	every year	JE		1		
	応用腐食防食学 Advanced Corrosion Engineering	every year	JE		1		
	応用塑性加工学 Advanced Plastic Forming	every year	J		1		
	応用粉体加工学 Applied Powder Processing and Powder Metallurgy	every year	E		1		
専門科目 Major General Subjects	応用接合工学 Advanced Welding and Joining Engineering	every year	JE		1		
	数値材料プロセス学 Numerical Methods for Materials Processing	every year	JE		2		
	弾塑性力学 Mechanics of Elasticity and Plasticity	every year	JE		1		
	計算材料学 Computational Materials Science	every year	JE		1		
	エネルギー変換・機能材料学 Energy Conversion and Functional Materials	every year	E		1		

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	 選択必須 Elective Required	 選択 Elective	備考 Remarks
	磁気デバイス材料学 Magnetic Device Materials	every year	JE		2		
	応用電子材料学 Materials Science of Electronic and Optoelectronic Devices	every year	JE		1		
	非平衡物質工学 Nonequilibrium Materials	every year	JE		1		
	先端材料評価学 Advanced Materials Characterization	every year	JE		1		
	材料計測学 Evaluation of Materials	every year	E		1		
	生体材料学 Biomaterials Science	every year	E		1		
	ソフトマテリアル Soft Materials	every year	E		1		
	ナノ構造制御機能発現工学 Nanostructures and Function Control in Materials	every year	E		2		
	光機能材料概論 Functional Optical Materials	every year	E		1		
	先進鉄鋼工学 Advanced Steel Engineering	every year	J		2		
	非鉄金属製錬環境科学特論 Non-ferrous Metallurgical and Environmental Science and Engineering	every year	J		1		
	インターンシップ研修 Internship training				1〜2		
	材料科学工学特別講義 Special Lectures on Material Science and Engineering						
	材料科学工学特別研修 Special Seminar on Material Science and Engineering						
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	接合界面制御学セミナー Seminar on Interface Science and Engineering of Joining	every year			4		
	マイクロシステム学セミナー Seminar on Microsystems Design and Processing	every year			4		
	生体材料システム学セミナー Seminar on Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems	every year			4		
	物質構造評価学セミナー Seminar on Structural Characterization of Materials	every year			4		
	材料機械制御プロセス学セミナー Seminar on Processing for Materials Function Control	every year			4		
	材料システム高額修士研修 Research for Master's Thesis in Materials Processing	every year			6		

1，上記科目の単位数を合わせて 30 単位以上を修得すること。
Students must acquire 30 or more credits from the subjects above.
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

Thermodynamics of Smelting & Refining 2 credits
製錬・精製の熱力学
Elective Required
Prof. Hiroyuki Shibata, Hongmin Zhu, Shigeru Ueda, Takahiro Miki
Associate Prof. Sohei Sukenaga

The goal of this lecture is to apply the basic knowledge already learned about chemical thermodynamics necessary for the production of metal materials and the creation of new materials of steel and non-ferrous metals to actual smelting and refining processes, and to improve it to a level where they can be analyzed using thermodynamics. In the first half, as the basis for analyzing the material manufacturing process, multicomponent phase equilibrium, reaction path and phase analysis, electrochemistry, potential diagrams, thermodynamics, structure, physical properties (measurement method), solution model, etc. of melts and solutions are explained, and in the second half, steel smelting (iron and steelmaking) and non-ferrous metal smelting (base metals such as copper, zinc, lead, and rare metals) processes, Deepen understanding by introducing examples and exercises on analysis methods using chemical thermodynamics.

Reaction Kinetics in Metallurgical Processes 1 credit
製錬・精製の速度論
Elective Required
Prof. Hiroshi Nogami, Associate Prof. Shungo Natsui

The fundamental concepts of material processes are designed based on thermodynamics. It is necessary to evaluate and/or estimate the rate-determining process quantitatively for their actual process designs. In this course, the students will learn about the several kinetic processes that are taken out from the actual smelting and refining processes. In this lecture, we will introduce how the reaction kinetics and transport kinetics that we have learned so far are applied to the analysis of the phenomena that occur in the actual refining process. Specific topics will be type of reactor, mass balance, and kinetic analysis of gas-solid/gas-liquid heterogeneous reactions.

Science of Surfaces and Interfaces in Materials 2 credits
材料表面界面科学
Elective Required
Prof. Tomomasa Wadayama, Associate Prof. Kozo Shinoda

While the property of solid material originated from a volumetric property covering the whole solid, the atomic coordination is unsaturated on the surface of the solid, and the atomic arrangement is disturbed at the interface in the solid. Since these disordered atomic arrangements have a great influence on the physical properties of surfaces and interfaces, they form a discipline called surface and surface science. The purpose of this lecture is to understand various surface and interface phenomena in industrially important processes from the standpoint of basic physical properties. Specifically, in the first half, lectures will be given on the atomic arrangement of solid surfaces, thermodynamics and chemical bonds between surfaces and interfaces, and surface functions. In the second half, lectures will be given on analytical methods using ions for evaluating solid surfaces and thin film growth.

Theory of Phase Transformations 2 credits
相変態論
Elective Required
Prof. Ryosuke Kainuma, Yuji Sutou, Tetsu Ichitsubo, Toshihiro Ohmori

The purpose of the course is to make the participants understand the basic issues on phase transformations in materials on the basis of thermodynamics of microstructures. The main contents are ①phase diagrams and free energy (regular solution and sub-lattice models and phase equilibrium), ② thermodynamics on phase interface (grain boundary segregation and grain growth), ③diffusion phenomena (Fick’s laws and phenomenological diffusion equation), ④thermodynamics on nucleation, ⑤martensitic transformations (crystallographic phenomenological theory and transformation hysteresis and interval) and ⑥thermodynamics on microstructural change (JMAK equation and eutectic and eutectoid transformations).

Quantum Chemistry 1 credit
量子化学
Elective Required
Prof. Momoji Kubo, Associate Prof. Yusuke Ootani
Specially Appointed Associate Prof. Yayoi Terada

Most functions and properties of materials can be understood from the behaviors of atoms and electrons in materials. Conversely, understanding the behaviors of atoms and electrons realizes the theoretical design of the materials with high performance and functions. Here, understanding the behavior of electrons requires knowledge on the concept and method of quantum chemistry. Basics of quantum chemistry is Schrödinger equation and molecular orbital theory has grown and advanced on the basis of the Schrödinger equation. Solving electronic states of materials by molecular orbital theory and computer realizes the understanding and predicting of the functions and properties of materials. In this class, 1) atomic orbital and molecular orbital, 2) molecular orbital theory, 3) Hückel theory, and 4) band theory of solids are given for understanding the basics of the quantum chemistry. Textbook: Atkins Physical Chemistry (1), Tokyo Kagaku Doujin.

Materials Electrochemistry 2 credits
材料電気化学
Elective Required
Prof. Izumi Muto, Hongmin Zhu,
Associate Prof. Osamu Takeda, Yu Sugawara

The purpose of this course is to understand the theory and practical application of electrochemistry in materials science. This course is arranged into three parts. The first part deals with fundamentals of electrochemical equilibrium and reaction kinetics on metal electrodes in terms of electron transfer. In the second part, the method of electrochemical measurements is described. Third part covers characteristics of industrial electrolysis (chlor-alkali process, electrowinning of zinc, electrowinning of aluminum) and key points for establishing industrial electrolysis.

Fatigue Strength and Fracture of Materials 2 credits
疲労と破壊の材料学
Elective Required
Prof. Naoyuki Nomura, Kyosuke Yoshimi, Yoshikazu Ohara

The lecture will cover fatigue phenomena and fatigue strength of materials, fracture mechanics and fracture toughness, and the basics of fatigue crack initiation and propagation mechanisms, from the viewpoint of not only understanding microscopic phenomena of materials, but also how macroscopic deformation and fracture of materials are correlated with microscopic phenomena. The course will explain how these concepts can be applied to materials engineering and how macroscopic fracture mechanics parameters can be utilized to ensure the safety and reliability of structures.

Lattice Defects Theory 2 credits
格子欠陥論
Elective Required
Prof. Kyosuke Yoshimi, Associate Prof. Nobuaki Sekido

Material properties strongly depend on the type and concentration of lattice defects in the material. Lattice defects are always introduced in a certain amount by synthesis or processing, and their type and concentration change depending on the operating environment. Therefore, knowledge and understanding of the types and concentrations of lattice defects and their measurement methods are essential for material design to exploit the excellent properties of materials fully and to maintain stable properties over the long term. In this lecture, the structure and physical properties of point defects, line defects (dislocations), and plane defects in materials will be outlined, and the behavior of these lattice defects in materials and their effects on material properties will be introduced. Furthermore, examples where lattice defects play a vitally important role from a practical standpoint, such as irradiation damage, and methods for measuring lattice defect concentration will also be presented.

Structural Characterization of Materials 1 credit 材料構造評価学 Elective Required Prof. Kazumasa Sugiyama, Kenji Tsuda The course is divided into four major parts, each with the following keywords: symmetry, diffraction intensity, crystal structure analysis, and advanced quantum beam applications. Part 1: The hierarchy of crystals is studied, with symmetry of crystal structures as an important key word. Part 2: Understanding the phenomenon of X-ray interference from periodic atomic arrangements, the effects of factors such as the Bravais lattice, atomic arrangement in the unit cell, and the observed diffraction patterns are studied in terms of the reciprocal lattice, structure factor, and shape factor. Part 3: Topics related to the discussion of data obtained from single crystal structure analysis. Part 4: In the field of materials science, analysis using synchrotron radiation sources is widely used. There are several courses in our academic program, but we will focus on synchrotron radiation X-rays and study the state-of-the-art of this field	**Physics of Electrons in Solids** 2 credits 固体電子論 Elective Required Prof. Rie Umetsu, Makoto Kohda Associate Prof. Norihiko Okamoto In order to elucidate and control various functionalities used in recent materials, it is essential to develop a crystallographic background and to understand the behavior of electrons, phonons, and photons in solids and the fundamentals of solid-state physics. The following topics will be lectured on the subjects of electron transport properties such as electrical and thermal conduction, electrical and optical effects. (1) Symmetry operation, (2) point and space groups, (3) group theory, (4) physical property tensors, (5) free electron model, (6) electron transport properties, (7) energy bands, (8) electronic states of solids, (9) phonon dispersion relations I, (10) phonon dispersion relations II, (11) specific heat by optical and acoustic phonons, (12) quantization of phonon energy, (13) thermal expansion and heat conduction based on anharmonic terms, (14) reserve
Materials Theory 1credit 理論材料学 Elective Required Prof. Yu Kumagai, Associate Prof. Shota Ono First-principles calculations, which predict the properties of materials based on quantum mechanics, are an essential tool in the materials research. In this lecture, we will learn about the foundations of first-principles alculations and its application in material design. Additionally, we will study the latest research in materials informatics.	**Crystal Physics and Engineering** 1 credit 結晶物理工学 Elective Required Prof. Hitoshi Takamura, Akira Yoshikawa, Takahiko Terada Physical properties of functional materials, such as electrical and optical properties, are described by the symmetry of crystal structure and its local arrangement. This course delivers lectures on tensor representations of physical properties for crystalline materials and provides deep insights into their electrical and optical properties.
Iron and Steelmaking Process 1 credit 鉄鋼プロセス学 Elective Required Prof. Hiroshi Nogami, Shigeru Ueda, Hiroyuki Shibata The steel making process, which is the basic material supporting all industries, consists of blast furnace process for reducing iron ore, steelmaking for refining molten iron, and continuous casting for solidifying molten steel, and the process is efficiently mass-produced by precise sophisticated process control. In this lecture, the fundamentals of thermodynamics, reaction rate, transfer rate, solidification, etc., which have been studied up to now, are applied to the phenomena occurring in each process, and analytical methods to control them are introduced. Specifically, numerical analysis model of blast furnace based on heat and mass transfer considering solid/liquid/gas, control method of slag/metal reaction by competitive reaction model which can analyze simultaneous oxidation and reduction of various elements, outline of continuous casting process and analysis of initial solidification phenomenon considering solidification, heat transfer and flow, etc. will be lectured.	**Noufirrous Extractive Metallurgy** 1 credit 非鉄金属プロセス学 Elective Required Prof. Hongmin Zhu, Associate Prof. Osamu Takeda Non-ferrous metals are smelted utilizing physicochemical properties of the metals and their compounds. Operation temperatures are from a room temperature to over 2000 °C; phases involved for reaction are solid, liquid, gas, and their mixtures; reaction media are aqueous solutions, molten salts, and molten slags; reduction methods are thermochemical reduction using carbon, hydrogen, and reactive metal reductants and electrolytic reduction. Fundamental principles and characteristics of smelting processes are reviewed through potential-pH diagram and chemical potential diagram, and current progress of smelting technologies are introduced.
Advanced Structual Materials 2 credits 応用構造材料学 Elective Required Prof. Tadasshi Furuhara, Naoya Masahashi Associate Prof. Goro Miyamoto, Satoshi Semboshi, Kenta Yamanaka The purpose of this lecture is to understand the fundamental principles of microstructure controls in various metallic materials for structure parts, such as steels or non-ferrous metals and alloys. Fundamental microstructure changes such as phase transformations/precipitation or deformation/recrystallization, effects of alloying, or roles of thermomechanical processing are reviewed. Also, relationships between mechanical properties and microstructures are briefly summarized.	**Advanced Casting Technology** 1 credit 応用鋳造工学 Elective Required Prof. Hidemi Kato, Kozo Fujiwara, Associate Prof. Kenta Yamanaka, Junpei Okada This class summarizes the thermodynamics of solidification and its application to microstructural control in practical materials. Specifically, we firstly discuss the microstructural control of silicon for high efficiency solar cells and then the amorphization of this silicon during rapid solidification will be discussed based on the latest research results. In metals, after learning about amorphous alloys and metallic glasses obtained by rapid solidification of eutectic alloys, we will learn about the characteristics of solidification and its microstructure control in Additive Manufacturing and Liquid Metal Dealloying, which are focus on as new material processes.

Advanced Corrosion Engineering 1 credit 応用腐食防食学 Elective Required Prof.: Izumi Muto, Associate Prof. Yu Sugawara The purpose of this course is to understand the theory of metallic corrosion. This course is arranged into two parts. The first part deals with the fundamentals of electrochemical aspects of corrosion phenomena and corrosion kinetics. In the second part, corrosion-resistant alloys and corrosion monitoring are described.	**Advanced Plastic Forming** 1 credit 応用塑性加工学 Elective Required Prof. Katsunari Oikawa Many parts of industrial products are made by processing and forming materials. Most of the forming of these parts is conducted by processing using plastic deformation (plastic forming). Plastic forming as a giving shape technique differs from other methods such as cutting and shearing in that it requires less processing time and causes less loss of material. To understand plastic deformation, it is necessary to understand the concepts and methods of mechanics of plasticity. In this course, principles of mechanics of plasticity will be lectured, and the analysis of typical plastic working for metals will be lectured.
Applied Powder Processing and Powder Metallurgy 1 credit 応用粉体加工学 Elective Required Prof. Naoyuki Nomura, Associate Prof. Zhou WeiWei Lectures will be given on the basics of additive manufacturing (AM) and its surrounding processes. The feature of AM and its current situation will be introduced. Fabrication process, evaluation method, and safety of powders used for AM process will be lectured. Lectures will be given on the following items. 1. Introduction of AM 2. Basics of AM and its surrounding process 3. Fabrication process, evaluation method, and safety of powders for AM 4. Application and recent study on AM	**Advanced Welding and Joining Engineering** 1 credit 応用接合工学 Elective Required Prof. Yutaka Sato Details of principles, phenomena and mechanisms of advanced welding and joining processes, and the knowledge to control quality, properties and microstructure of the welded materials and welded interfaces during processes, based on chemical and physical metallurgy, and materials science, will be given. The course is concerned with technically and economically feasible solutions to problems in advanced welding and joining processes.
Numerical Methods for Materials Processing 2 credits 数値材料プロセス学 Elective Required Prof. Hiroshi Nogami, Associate Prof. Shungo Natsui A wide variety of materials and formed materials are used in industrial products. In order to secure the cost and quality required for raw materials and fabricated materials, it is important to optimize parameters in material process. Physical phenomena in the material processing are often unsteady and nonlinear, and numerical analysis techniques are essential for optimizing process parameters. It is important to fully understand the principles of the numerical analysis model used, and at the same time to be aware of the model's limitations. In this lecture, students will learn the fundamentals of numerical analysis technique and its application to material processing.	**Mechanics of Elasticity and Plasticity** 1 credit 弾塑性力学 Elective Required Prof. Fumio Narita The primary objectives of this lecture are: (1) to develop a thorough understanding of the relations between the stresses (loads) applied to a structure under various environments and the resulting strains (deformations) of the structure; and (2) to develop adequate numerical procedures for finding the required materials and structures to carry a given load under a severe environment. The principles used to meet the design requirements of the materials and structures are included.
Computational Materials Science 1 credit 計算材料学 Elective Required Prof. Momoji Kubo, Associate Prof. Rodion Belosludov, Yusuke Ootani Specially Appointed Associate Prof. Yayoi Terada, Materials functions and properties are multi-scale phenomena and have extremely strong non-linearity because micro-scale information such as electron behaviors and atomic arrangements affects macro-scale functions and properties through the group dynamics of atoms on meso-scale.Therefore, understanding of the scientific principle on the behaviors of principal elements in each scale is significantly important. In this lecture, basic concepts of Hartree-Fock, Post-Hartree-Fock, and DFT methods are given for understanding the behaviors of electrons and atoms on micro- scale. In addition, basic concepts of molecular dynamics and Ginzburg- Landau methods are given for understanding the group dynamics of atoms on meso-scale. Furthermore, basic concepts of deep learning are given for understanding material informatics technologies that have been attracted recently.	**Energy Conversion and Functional Materials** 1 credit エネルギー変換・機能材料学 Elective Required Prof. Hitoshi Takamura, Hiroshi Masumoto Functional materials for energy conversion have been attracting much attention. This course delivers the fundamentals and applications of such functional materials: 1) materials for fuel cells and secondary batteries, 2) materials design for energy carrier production such as hydrogen, and 3) piezoelectric and thermoelectric materials.
Magnetic Device Materials 2 credits 磁気デバイス材料学 Elective Required Prof.Takeshi Seki, Associate Prof. Nobuki Tezuka, Lecturer. Masashi Matsuura Adjunct Instructor Seiji Mitani Magnetic materials have been developed using magnetic properties of various materials. Recently, spintronics is one of the attractive research areas, which is related to various kinds of magnetoresistance effects such as the giant magnetoresistance (GMR) effect and the tunnel magnetoresistance (TMR) effect. This course is dedicated to understand the basis of soft magnetic and hard magnetic materials and recent topics on nanomagnetic structures. In addition, the recent development of spintronics and its applications will be also presented.	**Materials Science of Electronic and Optoelectronic Devices** 応用電子材料学 1 credit Elective Required Prof. Akira Yoshikawa, Associate Prof. Yuichi Kozawa The physical properties, crystal growth technology and emerging functions and applications of electronic materials that realize semiconductor devices, lasers, and scintillation detectors will be lectured focusing on the following topics. 1. Material Issues of Semiconductor Devices 2. Ultra-fast and High-frequency Semiconductor Electronic and Photonic Devices 3. Crystal Growth and Semiconductor Device Epitaxy & Device Grade Evaluation of Semiconductor Crystals 4. Operation principle and fundamentals of laser 5. Laser Applications 6. High Temperature Bulk Crystal Growth 7. Applications for Scintillation Devices

Nonequilibrium Materials 1 credit
非平衡物質工学
Elective Required
Prof. Hidemi Kato, Junji Saida, Tetsu Ichitsubo, Associate Prof. Takeshi Wada

In this lecture we will learn synthesis, structure, mechanical, physical and chemical properties of materials with novel structure. They are amorphous and quasi-crystalline materials without long-range periodicity in atomic arrangement and nanocystalline materials containing high volume fraction of grain boundary. Non-equilibrium processes for synthesizing such novel materials, including rapid solidification, vapor condensation, solid state reaction and slow solidification, will be explained. Fundamental properties of bulk metallic glasses(BMGs) including high strength, toughness and superplasticity by Newtonian viscous flow, will lectured. The application of BMGs for advanced functional materials for soft magnetism, magnetic permeability, permanent magnet, magnetostriction, corrosion resistance, fuel cell and catalyst will be introduced.

Advanced Materials Characterization 1 credit
先端材料評価学
Elective Required
Prof. Kenji Tsuda, Kazumasa Sugiyama

Based on the basics learned in the lecture Structural Characterization of Materials, advanced materials characterization methods using electron microscopy and electron diffraction are explained. The following items are described: Electron diffraction theory, Symmetry determination and local crystal structure analysis by Convergent-Beam Electron Diffraction, Diffraction contrast and phase contrast of Transmission Electron Microscopy images, Electromagnetic field analysis by Electron Holography, Compositional and electronic state analysis by Scanning Transmission Electron Microscopy and Analytical Electron Microscopy.

Evaluation of Materials 1 credit
材料計測学
Elective Required
Prof. Atsushi Momose, Yoshikazu Ohara

Focusing mainly on methods using X-rays and ultrasonic waves for the methods of measurements and evaluations needed for sophisticated and safe uses of metals, piezoelectric materials, nano materials, polymers, composite materials, and devices and structural elements composed by them, their principle and application technology are described.
We deepen the understanding on X-ray diffraction/scattering/spectroscopy/imaging and ultrasonic wave propagation and its applications for measurements.

Biomaterials Science 1 credit
生体材料学
Elective Required
Prof. Takayuki Narushima, Masaya Yamamoto Associate Prof. Kyosuke Ueda

In the super-aging society, expectations for biomaterials are high and various functions are required. This course covers the design, physical, mechanical, chemical, and biological properties of metallic, ceramic, and polymeric biomaterials used for biofunctional reconstruction, therapy, and diagnosis. In addition, their biological reactions with hard and soft tissues and evaluation methods are lectured. The purpose of this course is to deepen understanding of the fundamental characteristics of biomaterials.

Soft Materials 1 credit
ソフトマテリアル
Elective Required
Prof. Masaya Yamamoto

Soft materials include liquids, polymers, gels, colloidal particles, liquid crystals, and many biological materials. A common feature of these soft materials is that the constituent molecules form mesoscopic structures due to intermolecular forces. As a result, they exhibit scale-dependent softness and slow dynamics. This lecture will introduce the thermodynamics and dynamics characteristics of soft materials. Examples of their applications will also be outlined.

Nanostructures and Function Control in Materials 2 credits
ナノ構造制御機能発現工学
Elective Required
Prof. Yuji Sutou, Makoto Kohda, Mikihiko Ogane, Takeshi Seki

In current materials science, to develop new functional materials, we have to control the crystal structure and microstructure of materials at nanoscale. In this lecture, the basics of physics and materials science related to the microstructure and device structure control at nanoscale will be explained, and new functions (mainly electromagnetic functions) that emerge based on various nanostructures will be introduced and discussed. We will also discuss how these functions are applied to devices beyond the traditional framework of metals and semiconductors.

Functional Optical Materials 1credit
光機能材料特論
Elective Required
Prof. Chao-nan Xu, Adjunct Instructor

This lecture covers the fundamentals and applications of photonic materials and discusses future outlook. The objective is to comprehensively understand natural and artificial photonic materials, starting from an overview and encompassing the basics, manufacturing processes, characteristics, applications, and recent developments in representative optical materials.

Advanced Steel Engineering 2 credits
先進鉄鋼工学
Elective Required
Prof. Takahiro Miki,
Specially Appointed Prof. Yuji Miki, Ichikawa Kazutoshi
Visiting Prof. Masafumi Miyazaki

Iron/steel is the most used material on the earth, and steels are manufactured by controlled large-scale processing, whose microstructure was analyzed and controlled at the atomic scale. In this course, the students will learn the basic aspects of the state-of-the-art technology related to steel, based on materials science and processing, and the connection and applied skill to fundamental sciences. The lecture consists of the steel making processing, environmental issues of steel making, control of microstructure and surface of steel products, and latest evaluation techniques including computational science for steels.

Non-errousMetallurgicalandEnvironmentalScienceandEngineering
非鉄金属製錬環境科学特論 1credit
Elective Required
Prof. Hiroyuki Shibata, Takahisa Omata, Hiroyuki Fukuyama, Atsushi Muramatsu
Part-time Lecturer to be announced

Non-ferrous materials such as copper and nickel are essential in a highly developed modern society. On the other hand, the resources available are limited, and the requirements for high-level resource processing and smelting technology are always high. An integrated understanding of non-ferrous resources to materials and recycling leads to an understanding of the arteries and veins of industry. University faculty members give lectures on the basics related to the smelting of materials, and corporate lecturers share the actual industrial process with lecturers.

Internship Training 1～2 credits
インターンシップ研修
Elective Required

Practical training and research activities will be conducted at companies as hands-on exercises for about 2 weeks to 1 month.

Special Lectures on Material Science and Engineering 材料化学工学特別講義 Elective Required These special lectures are designed to introduce important academic and research fields in specialized fields and related fields, and to promote professional knowledge and the creative development of scholarship related to research for Master's Thesis	**Special Seminar on Material Science and Engineering** 材料化学工学特別研修 Elective Required Acquire problem-solving ability by integrating advanced specialized knowledge through seminars and exercises inside and outside the university for important academic and research fields in specialized fields and related fields.
Seminar on Interface Science and Engineering of Joining 接合界面制御学セミナー 4 credits Elective Required Prof. Yutaka Sato Targeting the latest domestic and foreign researches related to master thesis research in Interface Science and Engineering of Joining group, students will be able to learn the research and introduction methods, and conduct discussions and exercises based on them.	**Seminar on Microsystems Design and Processing** 4 credits マイクロシステム学セミナー Elective Required Prof. Naoyuki Nomura, Yoshikazu Ohara, Chaonan Xu Associate Prof. Zhou WeiWei Targeting the latest domestic and foreign researches related to master's thesis research in the Microsystems Group, students will acquire the research and introduction methods, and conduct discussions and exercises based on them.
Seminar on Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems 4 credits 生体材料システム学セミナー Elective Required Prof. Masaya Yamamoto, Takayuki Narushima Associate Prof. Kyosuke Ueda Targeting the latest domestic and foreign researches related to master thesis research in Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.	**Seminar on Structural Characterization of Materials** 4 credits 物質構造評価学セミナー Elective Required Prof. Hisanori Yamane, Takahiro Yamada, Satoshi Kameoka Associate Prof. Rayko Shimira Lecturer. Nobuhisa Fujita Targeting the latest domestic and foreign researches related to master's thesis research in Structural Characterization of Materials Group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.
Seminar on Processing for Materials Function Control 4 credits 材料機能制御プロセス学セミナー Elective Required Prof. Akira Yoshikawa, Yu Kumagai, Rie Umetsu, Kenji Tsuda, Hiroshi Masumoto Targeting the latest domestic and foreign researches related to the master's thesis research in Materials Processing for Function Control Group, students will learn the research and introduction methods, and conduct discussions and exercises based on them.	**Research for Master's Thesis in Materials** 6 credits 材料システム工学修士研修 Elective Required All Professors Belonging to each group of Interface Science and Engineering, Biomaterials System group, Crystal Structure Evaluation, and Materials Processing for Function Control, students will conduct research, presentation, discussion, and literature introductions.

授業科目表（MC）Opening of a course class subject list

Department of Civil and Environmental Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	Numerical Analysis	Every year	JE		2		At least 4 credits must be earned from the major basic subjects listed on the left.
	Spectral Analysis	Every year	JE		2		
	Computational Solid Mechanics	Every year	JE		2		
	Continuum Mechanics	Every year	J		2		
	Construction Materials	Every year	JE		2		
	Geotechnical Engineering	Every year	J		2		
	Thin-Walled Structures	Every year	JE		2		
	Structural Design	Every year	JE		2		
	Environmental Microbial Engineering	Every year	J		2		
	Water Environment Engineering	Every year	JE		2		
	Ecological Engineering	Every year	JE		2		
	Data Science for Urban Transportation System	Every year	J		2		
	Project Evaluation	Alternate year	J		2		*Alternate year (even year)
	Transportation Systems Analysis	Every year	J		2		
	Micro Socio-Economic System	Every year	JE		2		
	Special Lectures on Civil and Environmental Engineering	Every year	J		2		
専門科目 Major General Subjects	Nonlinear structural analysis	Every year	JE		2		At least 10 credits must be earned in total from the major general subjects listed on the left and the major basic subjects listed above.
	Mechanics of Inhomogeneous Materials	Every year	JE		2		
	Maintenance Engineering	Every year	J		2		
	Computational Soil Mechanics	Every year	J		2		
	Computational Plasticity	Every year	JE		2		
	Design of Earthquake Resistant Structures	Every year	JE		2		
	Numerical Modeling of Water Waves and Currents	Alternate year	JE		2		
	Hydrology	Every year	E		2		
	Disaster Reduction System	Every year	JE		2		
	Environmental Reaction Engineering	Every year	J		2		
	Water Purification Engineering	Every year	JE		2		
	Ecological Impact Assessment	Every year	J		2		
	Mathematics for Applied Economics	Alternate year	J		2		* Alternate year (odd eyear)
	Quantitative Behavior Analysis	Every year	JE		2		
	Mathematical Modeling & Analysis of Urban Systems	Every year	J		2		
	Urban Landscape Design	Every year	J		2		
	Analysis of Social Institution	Every year	J		2		
	Game Theory for Applied Economics	Every year	JE		2		

	Spatial Economics	Every year	JE		2		
	Spatial Information Analysis	Every year	JE		2		
	Project Risk Management I	Every year	E		2		
	Internship training	Every year			2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Seminar on Mathematical System Design	Every year	JE		2		At least 2 credits must be earned from the seminars listed on the left.
	Seminar on Infrastructural Materials	Every year	JE		2		
	Seminar on Civil Engineering Structures	Every year	JE		2		
	Seminar on Hydraulics and Environmental Engineering	Every year	JE		2		
	Seminar on Regional System Engineering	Every year	JE		2		
	Master's Thesis Research in Civil and Environmental Engineering	Every year		8			

1，専門基盤科目，専門科目，関連科目，セミナー及び研修の単位数を合わせて 30 単位以上（うち，専門基盤科目から 4 単位以上，　専門基盤科目及び専門科目を合わせて 10 単位以上）修得すること。
Students must acquire 30 or more credits from the subjects above (including 4 or more credits from the major basic subjects, 10 or more credits in total from the major basic subjects and major general subjects).
2，「修士特別講義」は土木系以外の学部学科出身者のみが取得可能である。
The "Special Lectures on Civil and Environmental Engineering" can only be acquired by those who are from undergraduate departments other than civil and environmental engineering.
3，『開講時期』欄において，『毎年』は毎年開講，『隔年』は隔年開講科目を指す。開講年度などは授業時間割などで確認すること。
In the "Schedule" column, "Every year" refers to courses offered every year, and "Alternate year" refers to courses offered alternate year. Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
4，「使用言語」欄のアルファベット記号について
Language Key
J:日本語開講科目(Lectures given in Japanese)
E:英語開講科目(Lectures given in English)
JE:準英語開講科目(Lectures basically given in Japanese, with additional explanations or material in English for foreign students.)
5，教員所属組織名については，1 ページの別表を参照のこと。
Refer to a list on page 1 for the names of faculty members' affiliations.

Numerical Analysis 2 credits

Elective Required

Professor Keiko Udo, Associate Professor Shuji Moriguchi

The lecture will cover the fundamentals of numerical computation, such as computation concepts, error evaluation, and algorithms, and assignments will be given for understanding.

1. Fundamentals of numerical computation: interpolation, numerical integration, linear and nonlinear equation Solutions of linear and nonlinear equations, solutions of differential equations
2. Basic theory of difference, difference method (boundary value problems), difference equations
3. Instability problems of evolving equations, diffusion equation, wave equation
4. Numerical error analysis

Spectral Analysis 2 credits

Elective Required

Professor Fumihiko Imamura, Professor Yuki Yamakawa,
Associate Professor Yu Otake

This course aims at learning the basic theory and practical applications of spectral analysis for time-series data. In the first half, lectures are given on the overview and the fundamental mathematical theory of spectral analysis. In the second half, lectures are given on stochastic processes, their engineering applications, and time-series data analysis. The lecture goals will be achieved if students acquire the basics of utilizing spectrum analysis and time-series data analysis for their own research subjects.

Computational Solid Mechanics 2 credits

Elective Required

Professor Kenjiro Terada

This lecture will provide advanced topics in computational mechanics for the analysis and design of materials and structures, with an emphasis on introductory topics in one-dimensional nonlinear problems, such as contact problems, elastoplastic and viscoplastic material behavior, damage, etc. Some mathematical and technical aspects of the finite element method (FEM) will also be presented to understand approximate properties and related finite element techniques from the framework of variational methods. Also, students will also learn the process of discretization of the formulated mathematical models and how to implement them in computer programs.

Continuum Mechanics 2 credits

Elective Required

Professor Takashi Kyoya

Mathematical preparation (vector algebra, Cartesian tensor, tensor analysis) / Motion and deformation (motion and material derivative, finite deformation and polar decomposition, strain tensor, deformation rate) / Stress and equilibrium conditions (Cauchy stress and Piola - Kirchhoff stress, Momentum conservation law) / Work rate, energy conservation law / Stress rate, Objectivity principle, Constitutive law, Hyperelastic body, Isotropic elastic body

Construction Materials 2 credits

Elective Required

Professor Makoto Hisada, Associate Professor Hiroshi Minagawa

Associate Professor Shintaro Miyamoto

Construction materials to construct infrastructures must be durable and always produced with durability in mind. This lecture provides the basic knowledge for various deterioration mechanisms that reduce the durability of concrete structures and countermeasures in design, execution, and maintenance to prevent deterioration.

Geotechnical Engineering 2 credits

Elective Required

Professor Motoki Kazama

Students study geotechnical challenges related to social issues.
Topics are as follows:

1. Global level environmental problems and geotechnical engineering.
2. Waste ground, ground contamination and disposal of radioactive waste
3. Relationship between geology and geotechnical engineering.
4. Volcanic and mountain area disasters.
5. Tunnel engineering, construction incidents caused by ground water.
6. Problematic soils, geotechnical risk.
7. Prediction and countermeasures for liquefaction (advanced).

Thin-walled Structures 2 credits

Elective Required

Associate Professor Isao Saiki

Due to the high strength of steel, steel structures are often designed as thin-walled structures. The course focuses on geometric properties as the most important factors in determining structural strength. Students are taught the mechanical properties of thin-walled structures, methods for designing structures that exploit these properties, and methods for numerical analysis their ultimate behavior.

Structural Design 2 credits

Elective Required

Professor Shigeki Unjoh

Students will be taught the structural design methods which provide the bases to treat the uncertainty in the loads and strengths, and the mathematical modelling for the design of civil engineering structures. Classes will focus in particular on (1) uncertainty factors in structural design and safety factors, (2) concepts of limit state designs, (3) probabilistic model of loads and strengths, (4) basis of reliability design methods, (5) load combinations, and others, covering the bases of the structural design and the practical applications.

Environmental Microbial Engineering 2 credits

Elective Required

Professor Yu-You Li, Associate Professor Kengo Kubota

Phylogeny, taxonomy, physiology, dynamics, and the roles of environmental microorganisms in nature is lectured. Quantitative microbial reactions and environmental conservation technologies using biotechnology are also introduced to understand an overview of environmental microorganisms and their use in engineering. Acquire an ability to analyze microbial reactions and biological wastewater treatment processes.

Water Environment Engineering 2 credits

Elective Required

Professor Daisuke Sano

This lecture provides with methodologies for predicting water quality in various water bodies and modeling related to the dynamics and circulation of substances in aquatic environments based on Environmental Chemistry. Specifically, application examples of process models (ecosystem models), time series analysis (state space models), regularized regression, and chemical thermodynamics will be introduced, and the experience in environmental modeling will be gained through practice using actual datasets and R/Stan code

Ecological Engineering 2 credits
Elective Required
Associate Professor Takashi Sakamaki

This subject provides principles of ecological engineering which aims for sustainable use of ecosystem functions and restoration of damaged ecosystems. Class lectures focus on the mechanisms of biological diversity, its importance for ecosystem functions, food web dynamics, and nutrient cycling. Based on those knowledges, students are expected to discuss how we can sustainably use resources provided from biospheres, design sustainable social systems, and restore damaged ecosystems and their functions.

Data Science for Urban Transportation Systems 2 credits
Elective Required
Associate Professor Yusuke Hara

In this class, models and methods for analyzing various data in urban transportation system, especially, GPS trajectory data, human activity data, and mesh statistics are taught. We will learn how to interpret traffic behavior from trajectory data, how to model decision making, how to predict traffic conditions, and how to model transportation systems considering interactions. This class provides various urban and transportation data. Students will learn data handling techniques and data science methodologies to be applied to urban and transportation planning by using computers. Students are expected to present their final analysis results in class.

Project Evaluation 2 credits
Elective Required
Professor Tatsuhito Kono

This course pays attention to the public projects such as constructions, improvements of roads, railways, ports, airports, dams, breakwaters, urban redevelopments, parks, and anti-disaster prevention. The objective of this course is to study the theory and practical methodology to analyze the influences of those projects and to evaluate those from the viewpoint of socio-economics. The main topic is cost benefit analysis.

Transportation Systems Analysis 2 credits
Elective Required
Professor Takamasa Iryo

This course provides an overview of the basics of traffic flow theory and transport network theory. Through analyses and calculations with simple examples, the course provides the fundamentals of the methodology of transport system analysis. Study topics include:

- Fundamental diagrams.
- LWR model, cell transmission model
- Traffic assignment problems, user-equilibrium assignment
- Dynamic traffic assignment problems
- Game theory in transport network analysis

Micro Socio-Economic System 2 credits
Elective Required
Associate Professor Ryo Itoh

The goal of this lecture is to learn the basics of microeconomics from the perspective of "economics as a science" and to acquire the ability to solve various economic problems.

Specifically, I will talk about the utility function of consumers, utility maximization and expenditure minimization, production function and profit function, corporate behavior, elasticity, imperfect competition, supply-demand equilibrium, general equilibrium and the basics of public economics, and comparative static analysis of these problems. These contents form the basis of the "Urban Economic Analysis" course offered in the second semester.

Special Lectures on Civil and Environmental Engineering 2 credits
Elective Required
All teachers

This course is a special lecture for students who are not civil engineering majors. This course aims to enhance students' professional knowledge of civil engineering by introducing the basics and the latest topics in civil engineering.

Nonlinear structural analysis 2 credits
Elective Required
Associate Professor Shotaro Yamada, Professor Yuki Yamakawa, Associate Professor Isao Saiki

In this lecture, the following topics will be explained and practiced.

(1) Multidimensional nonlinear structural analysis methods
(2) Basics of numerical analysis of buckling stability problems of various structural members and structures
(3) Plasticity analysis methods and plasticity design methods for basic structural members such as columns, beams, and frames

Mechanics of Inhomogeneous Materials 2 credits
Elective Required
Professor Kenjiro Terada, Shuji Moriguchi

This course presents basic theories of mechanics and numerical simulations that enable us to understand mechanical behavior of heterogeneous materials such as geomaterials, fiber-reinforced plastics, etc. In the first part, the mixture theory, the homogenization theory, the laminated plate theory within the continuum mechanics framework will be introduced and relevant methods for numerical simulations are explored. In the second part, characteristics of granular materials and a representative numerical method based on discrete modeling will be introduced. The aim of this course is to help students to understand the macroscopic mechanism underlined in the microscopic behavior of heterogeneous media and acquire a basic skill to utilize it in practice.

Maintenance Engineering 2 credits
Elective Required
Professor Makoto Hisada, Associate Professor Hiroshi Minagawa, Lecturer Tetsuya Mizutani

Focusing on the types and applications of reinforced concrete structures, this lecture introduces the current status and future direction of maintenance management technology according to each degradation mechanism.

(1) Concept of maintenance
(2) Degradation factor and mechanism
(3) Technology of inspection, monitoring, and assessment
(4) Technology of repair and strengthening

Computational Soil Mechanics 2 credits
Elective Required
Associate Professor Shotaro Yamada, Associate Professor Akiyoshi Kamura

The first half of the course is devoted to understanding geotechnical behavior during earthquakes, which requires a high level of mechanical evaluation in geotechnical engineering, and to explaining the basic knowledge required in seismic design practice.

In the latter part of the lecture, the constitutive laws of the soil skeleton and the theory of mixtures are explained as the basis for understanding the latest theories of effective stress analysis.

Computational Plasticity 2 credits
Elective Required
Professor Yuki Yamakawa, Associate Professor Isao Saiki

This course aims at learning the fundamental theory of constitutive equation for various solid materials, with a focus on elasticity, plasticity, and other classes of inelasticity. Numerical formulation and implementation for various types of constitutive models are also addressed, which are necessary in nonlinear finite element analysis of solids and structures. Starting from a review on the basics of continuum mechanics, the topics of this course encompass an introduction of one-dimensional model for plasticity, generalization to three-dimensional constitutive theory, and then specific plasticity models for various engineering materials, such as metals, geomaterials, rocks, and concretes. The main focus is placed on the constitutive theory within the small-strain framework, while the latter part of the course will be devoted to the advanced theory for finite-strain elastoplasticity.

Design of Earthquake Resistant Structures 2 credits
Elective Required
Professor Motoki Kazama
Associate Professor Hideki Naito

Students will learn concepts and methods of geotechnical and structural seismic design. In particular, the classes will focus the below subjects.
1. Seismic damage of the ground
2. Seismic performance of the ground
3. Seismic evaluation of the ground in nuclear power plants
4. Limit states of structures for a large earthquake
5. Dynamic response analysis for civil structures
6. Seismic design of reinforced concrete bridge piers

Numerical Modeling of Water Waves and Currents 2 credits
Elective Required
Professor Shunichi Koshimura, Professor Keiko Udo,
Assosciate Professor Anawat Suppasri

This course focuses on developing "tools" for numerical modeling the processes of river, ocean currents and waves, and the transport of materials caused by these currents and waves. The governing equations, boundary conditions, and numerical schemes will be introduced according to the purpose, needs and requirements of the modeling.

Hydrology 2 credits
Elective Required
Professor So Kazama, Associate Professor Daisuke Komori

This lecture focuses to study hydrology based on physical (Hydrological processes, Hydrological model) and statics approaches (Frequency analyses, Temporal and spatial analyses) for analyzing the water problems by changes in the distribution, circulation, or temperature of the earth's waters, and to provide guidance for the planning and management of watershed environment in view of economics and politics. Finally, we will have discussion about human security on watershed environment and water.

Disaster Reduction System 2 credits
Elective Required
Professor Fumihiko Imamura, Professor Shunichi Koshimura,
Lecturer Ikuo Abe

The class introduces an overview of the natural disasters that have occurred in Japan, such as earthquakes, volcanic eruptions, tsunamis, and floods as well as environmental disasters. In addition, modern cities and disasters, crisis management, disaster surveys, and the history of disaster countermeasures in Japan and others are discussed. Countermeasures, their histories, and issues in Japan are comprehensively compiled and the system and information to reduce losses for each hazard are discussed. Comparative study on disasters, statistics, and community map for disaster prevention are introduced.

Environmental Reaction Engineering 2 credits
Elective Required
Professor Yu-You Li, Associate Professor Kengo Kubota

Mass transfer and conversion, chemical reaction and equilibrium, process engineering and resource recycling systems related to global environmental issues as well as environmental conservation technologies will be lectured to acquire an ability to analyze important reaction processes and applied systems in environmental engineering.

Water Purification Engineering 2 credits
Elective Required
Professor Daisuke Sano

Uncertainty in securing water resources due to climate change is casting a shadow on the sustainability of human society. Reclaimed wastewater is recognized as an important water resource, but with direct and indirect wastewater reuse being carried out around the world, how to ensure human health in water usage is very critical. In this lecture, you will learn about environmental epidemiology, quantitative microbial risk assessment (exposure assessment, dose-response assessment, etc.), chemical risk assessment, risk trade-offs, and other topics from a global health perspective, and gain experience in evaluation of water-related disease burdens through exercises using R codes.

Ecological Impact Assessment 2 credits
Elective Required
Professor Osamu Nishimura

Various environmental impacts caused by human activities are changing ecosystems on a regional to global scale, threatening the survival of all living things. To address this, ecosystem impacts must be assessed and managed appropriately. This lecture will cover the following topics related to ecosystem impacts and ecosystem management.
1. Ecotoxicity assessment of hazardous chemicals
2. Ecological risk
3. Evaluation by model of ecological impact
4. Ecosystem management through nature restoration
5. Assessing the value of ecosystems

Mathematics for Applied Economics 2 credits
Elective Required
Professor Tatsuhito Kono

By studying economics, we learn how we can apply mathematical tools to economic analyses. I basically focus on mathematical tools rather than economics, but I hope that you all students develop economic intuition in this course. The mathematical tools we learn are shown below. Studying typical mathematical tools used in applied economics (e.g, public economics, urban economics, environmental economics), students learn how to systematically analyze economic systems.

Quantitative Behavior Analysis 2 credits
Elective Required
Professor Makoto Okumura

To learn theoretical bases, estimation method, application examples of the statistical models frequently used for behavior analysis; Generalized linear model (GLM). Applications to risk related cognition and behavior will be focused. It includes PC exercise using R language. Students will be able to formulate, to estimate on data and to discuss the result with confidence of statistical knowledge. That methods will be applied to analyze human behavior, especially risk-related matters.
Presentation and short report on your statistic model analysis on your own subject. You select a GLM, which is suitable to the data generation process and observation process of your topic.

Mathematical Modeling & Analysis of Urban Systems 2 credits
Elective Required
Professor Takashi Akamatsu

Modeling and quantitative analysis of spatial economic systems are indispensable for planning, analysis and evaluation of infrastructure systems. This lecture provides the basic framework and systematic methodology for this purpose. We will first introduce standard equilibrium models for transportation/communication networks and urban land use, which can be expressed in a unified manner as potential games and variational inequality problems (VIPs). Systematic methods for analyzing model properties and developing computational algorithms will then be presented. Furthermore, the relationship between the VIPs and the theory of population games and evolutionary game dynamics will be discussed.

Urban Landscape Design 2 credits
Elective Required
Associate Professor Katsuya Hirano

Urban design reached a major turning point in the 1960s with the assertion by K. Lynch and J. Jacobs. The trend of urban design changed greatly from a functionalist view of the city to a humanistic view of the city. In this lecture, we will read the trend of urban design from the viewpoint of landscape based on human spatial experience, and consider the future of urban design. Furthermore, we will systematically learn how humans understand cities, their scientific understanding, analytical methods, and design/planning techniques.

Analysis of Social Institution 2 credits
Elective Required
Associate Professor Junya Fukumoto

In this lecture, students will learn the economic theory of contract, which helps them to understand the significance and characteristics of various institutions and organizations and to design better mechanism. The economic theory of contract consists of complete and incomplete contract theory. The former is subdivided into moral hazard and adverse selection. Students will learn the essence of each part and how to apply those to real-world problems through various applications.

Game Theory for Applied Economics 2 credits
Elective Required
Professor Zeng, Dao-Zhi

Game theory studies how several intelligent and rational individuals make their decisions. In most part of this lecture, students will learn noncooperative game theory, which considers the case that different players have conflicting interests and they interact with each other. I will introduce the concepts of matrix game, extensive game, repeated game, evolutionary game, Nash equilibrium, Subgame perfect equilibrium, and Nash bargaining solution. Some applications in economics will be illustrated for students to deepen understanding of the essence.

Spatial Economics 2 credits
Elective Required
Professor Zeng, Dao-Zhi

Spatial economics clarifies economic mechanisms for regional industrial agglomeration and international trade by incorporating spatial factors into traditional economics. First, I will explain some basic knowledge to understand several well-known models in international trade and regional economics established in recent decades. Second, I will introduce some research frontier topics. Moreover, some interesting applications of theoretical results to related fields will be illustrated. To understand this course, you are expected to have some basic knowledge of microeconomics.

Spatial Information Analysis 2 credits
Elective Required
Associate Professor Ryo Inoue

This lecture covers the statistical analysis methods for spatial information. Spatial information is data that is related to spatial positions and is useful information to understand the current conditions of cities and regions. The spatial information is divided into three types: spatial point pattern data such as locations of facilities, observation data at certain locations such as temperature data, and aggregated data by certain spatial boundaries such as population of municipalities. These data types require different methods to analyze. The purpose of lecture is to study the statistical analysis methods of spatial data in a comprehensive manner, considering their similarities and differences.

Project Risk Management I 2 credits
Elective Required
Professor So Kazama, Associate Professor Takako Izumi

The purpose of this course is to understand the types, magnitude, and importance of risks for the implementation of development projects and overseas cooperation projects, and to understand the types of avoidance and the notes of the avoidances for the risks from the point of view of the actual implementation. Through these understandings, the course aims to cultivate the ability to plan and carry out projects. In the lectures, not only explanations from a theoretical aspect but also introductions to many cases expect students to understand the reality of project risk management.

Internship training 2 credits
Elective Required
All teachers

Students will be placed for a short period in various organizations, such as government agencies and private companies, to learn how the methodologies and ideas of civil engineering are applied to the actual planning and construction of civil engineering projects through hands-on experience.

Seminar on Mathematical System Design 2 credits
Elective Required
Professor Yuki Yamakawa

In this seminar, students in the mathematical system design group will introduce and discuss their master thesis research and the latest related domestic and international research papers.

Seminar on Infrastructural Materials 2 credits
Elective Required
Professor Motoki Kazama, Professor Takashi Kyoya, Professor Makoto Hisada, Professor Kenjiro Terada, Associate Professor Hiroshi Minagawa, Associate Professor Shuji Moriguchi, Associate Professor Shotaro Yamada, Associate Professor Akiyoshi Kamura, Associate Professor Shintaro Miyamoto

In this seminar, students in the infrastructural materials group will introduce and discuss their master thesis research and the latest related domestic and international research papers.

Seminar on Civil Engineering Structures 2 credits

Elective Required

Professor Shigeki Unjoh, Associate Professor Isao Saiki, Associate Professor Hideki Naito

In this seminar, students in the civil engineering structures will introduce and discuss their master thesis research and the latest related domestic and international research papers.

Seminar on Hydraulics and Environmental Engineering 2 credits

Elective Required

Professor So Kazama, Professor Yu-You Li, Professor Daisuke Sano, Professor Fumihiko Imamura, Professor Shunichi Koshimura, Professor Keiko Udo, Associate Professor Kengo Kubota, Associate Professor Daisuke Komori, Associate Professor Anawat Sappasri

In this seminar, students in the hydraulics and environmental engineering group will introduce and discuss their master thesis research and the latest related domestic and international research papers.

Seminar on Regional System Engineering 2 credits

Elective Required

Professor Osamu Nishimura, Professor Makoto Okumura, Associate Professor Katsuya Hirano, Associate Professor Takashi Sakamaki, Associate Professor Yu Otake

In this seminar, students in the regional system engineering group will introduce and discuss their master thesis research and the latest related domestic and international research papers.

Master's Thesis Research in Civil and Environmental Engineering

Required 2 credits

All teachers

In this seminar, students in each study group, such as Mathematical System Design, Infrastructural Materials, Civil Engineering Structures, Hydraulics and Environmental Engineering, and Regional System Engineering, will explain and discuss their research, introduce the related papers, and conduct experiments and practices.

授業科目表（MC）Opening of a course class subject list

Department of Architecture and Building Science

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	建築デザイン論 Architecture Design	毎年 Every Year	J		2		左記の専門基盤科目から，8 単位以上を選択履修すること。 Students must acquire 8 or more credits from the major basic subjects listed on the left.
	都市デザイン論 Urban Design	毎年 Every Year	JE		2		
	建築史学 History of Architecture	毎年 Every Year	J		2		
	都市計画論 Urban Planning	毎年 Every Year	JE		2		
	計画デザイン論 Theory of Architectural Programming and Design	毎年 Every Year	JE (※)		2		
	都市・建築環境解析学 Numerical Analysis of Indoor and Outdoor Environment	毎年 Every Year	JE		2		
	建築設備設計論 Design of Building Facilities	毎年 Every Year	J		2		
	居住環境設計論 Indoor Climate Design for Human Occupancy	毎年 Every Year	JE		2		
	構造性能制御学 Performance Control of Building Structure	毎年 Every Year	J		2		
	最適減災技術学 Technology for Optimum Mitigation	毎年 Every Year	J or E		2		
	地震災害制御学 Earthquake Disaster Control	毎年 Every Year	JE		2		
	建築信頼性工学 Reliability Engineering	毎年 Every Year	J		2		
	建築数理基礎論 I Theoretical Basis of Mathematics and Dynamics in Building Engineering I	毎年 Every Year	J		1		
	建築数理基礎論 II Theoretical Basis of Mathematics and Dynamics in Building Engineering II	毎年 Every Year	JE		2		
	建築応用システム開発論 I Development of Applied Computer System in Architecture I	毎年 Every Year	J		2		
	都市・建築設計 I Urban and Architectural Design I	毎年 Every Year	J		4		
	都市・建築設計 II Urban and Architectural Design II	毎年 Every Year	J		4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認めたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						

専門科目 Major General Subjects	都市・建築理論 Urban and Architectural Design Theory	毎年 Every Year	J		2		左記の専門科目から 8 単位以上を選択履修すること。ただし本要件については,「インターンシップ研修 A1～6」及び「学外研修」は,合計 4 単位までしか認めない。 Students must acquire 8 or more credits from the major general subjects listed on the left. However, Internship Training A1-6 and Extramural Practice which may be included in the above 8 credits are limited to 4 credits.
	建築 IT コミュニケーションデザイン論 Architectural IT Communication Design	毎年 Every Year	JE		2		
	プロジェクトデザイン論 Project Design	毎年 Every Year	J		2		
	建築世界遺産学 The World's Architectural Heritage	毎年 Every Year	J		2		
	公共建築計画論 Architectural Programming for the Public	毎年 Every Year	J		2		
	サステナブル建築論 Sustainable Building	毎年 Every Year	JE		2		
	建築環境性能評価論 Assessment of Environmental Performance of Buildings	毎年 Every Year	JE		2		
	ライフタイム工学 Lifetime Engineering	毎年 Every Year	E		2		
	新材料・構法創生学 Methodology on New Materials based Structural System	毎年 Every Year	J		2		
	適応設計工学 Adaptive Design of Buildings	毎年 Every Year	JE		2		
	都市安全学 Urban Seismic Risk	毎年 Every Year	J		1		
	災害危機管理論 Crisis & Risk Management for Disaster Mitigation	毎年 Every Year	J		2		
	建築応用システム開発論 II Development of Applied Computer System in Architecture II	毎年 Every Year	JE		2		
	都市・建築学修士特別講義 Special Lecture for Master Course in Architecture and Building Science				2		
	建築構造実験 Experiments of Building Structures				2		
	環境設備実習 Exercise in Environmental Engineering and HVAC System Design				2		
	インターンシップ研修 A1 Internship Training A1				1		
	インターンシップ研修 A2 Internship Training A2				1		
	インターンシップ研修 A3 Internship Training A3				1		
	インターンシップ研修 A4 Internship Training A4				1		
	インターンシップ研修 A5 Internship Training A5				1		
	インターンシップ研修 A6 Internship Training A6				1		

	学外研修 Extramural Practice				1～4		
	都市・建築デザイン学セミナー Seminar on Architecture and Urban Design	毎年 Every Year	J		2		左記のセミナーから 2 単位以上選択履修すること。 Students must acquire 2 or more credits from the seminars listed on the left.
	都市・建築計画学セミナー Seminar on Architecture and Urban Planning	毎年 Every Year	J		2		
	サステナブル空間構成学セミナー Seminar on Sustainable Architecture and Building Science	毎年 Every Year	J		2		
	建築構造工学セミナー Seminar on Structural Engineering for Architecture	毎年 Every Year	J		2		
	都市・建築学修士研修 Research for Master's Thesis in Architecture and Building Science				8		左記の科目から 8 単位選択履修すること Students must acquire 8 or more credits from the subjects listed on the left.
	都市・建築学修士設計 Design for Master's Thesis in Architecture and Building Science				8		

（※日本語による講義は通常時間割通り提供。英語による講義は集中講義として提供）
Lectures in Japanese are offered according to the regular schedule.
Lectures in English are offered as intensive courses.

1，所属専攻の授業科目を 26 単位以上，合計で 30 単位以上修得すること。
Students must acquire 26 or more credits from courses in their major, for a total of 30 or more credits.

2，表中の授業科目は，1 週の授業時間数を示すものであるが，その配置は変更すること，または期間を区切って集中的に実施することがある。
Lectures in the table indicate the number of lecture hours per week. However, their arrangement may change or may be concentrated in certain periods.

3，本専攻の所定の科目を取得し修了することにより，一級建築士の受験資格として必要とする実務経験について 1 年間又は 2 年間が認定される。詳細については，新入生入学ガイダンス等に確認すること。
Upon completion of the prescribed classes in this major, one or two years of work experience required to qualify for the examination for the first-class architects will be approved. For details, check with the new student admission guidance, etc.

4，『開講時期』欄において，『毎年』は毎年開講，『隔年』は隔年開講科目を指す。開講年度等は授業時間割等で確認すること。
The schedule in the table indicates that "every year" refers to courses offered every year, and "every other year" refers to courses offered every other year. Be sure to check the fiscal years in which each class is offered with the time schedule of the classes, program syllabus, etc.

5，『使用言語』欄のアルファベット記号について
Language Key
J:日本語開講科目（Lectures in Japanese）
JE:準英語開講科目（Lectures basically in Japanese, with English explanations）
J or E:日本語・英語隔年開講科目（それぞれの開講年度は授業時間割等で確認すること）（Lectures in Japanese or English every other year. Check the timetable to see in which year the lecture is in English.）

Architecture Design 2 credits

Elective Required

Professor Taro Igarashi

Contemporary architectural design is affected by various phenomena. This lecture will set specific theme related to culture or society, then analyze method and meaning of design from interdisciplinary viewpoint. Result will be judged on number of days one has attended, a paper at the end of semester, oral presentation and discussion about theme.

Urban Design 2 credits

Elective Required

Professor Aya Kubota

Learn (1) the methodology for understanding the field through historical research and analysis of the actual situation of cities and regions, and (2) the deep wisdom accumulated in practice. Academics and practitioners will be invited. Through the onsite survey, the discussions on the day, preparations and reflection of lectures, I would like you to think about your own issues and attitudes regarding territorial design. Grading will be based on reports, presentations, and contributions made during lectures.

History of Architecture 2 credits

Elective Required

Associate Professor Shunichi Nomura

Architectural historiography examines the form and technique of architecture, its design and function, and the society and culture that form its background. For example, to consider a Buddhist temple, we must solve many problems, including not only the structure with columns and beams that make up the space but also the Buddhist statues dedicated inside the temple, the rituals that took place inside the temple, the murals that solemnize the space, the Buddhist philosophy that encompasses the entire building, and the political agenda of the clients and users who run the temple. It is no exaggeration to say that architectural historiography is a system of study that recognizes various images of the world through architecture. What are the methods of architectural historiography? In this lecture, we will discuss the methodology of architectural historiography, taking up previous critical studies. We will consider a framework for understanding the world image of architecture based on literary and pictorial sources, as well as actual historical buildings.

Urban Planning 2 credits

Elective Required

Professor Michio Ubaura

After learning in general terms about dispute prevention mechanisms and ex post facto relief systems for architecture, urban planning, and community development, students will analyze and discuss various urban development ordinances, lawsuits, and dispute cases from urban planning and legal perspectives to deepen their understanding of the actual situation and issues of conflict prevention and resolution in architecture, urban planning, and community development.

Theory of Architectural Programming and Design 2 credits

Elective Required

Professor Yasuaki Onoda

Associate Professor Haruka Tsukuda

This class will cover a wide range of topics from global trends in research of Human Behavior to the treatment of "space" in various philosophical and sociological theories. The class will consist of a lecture/report section introducing each theory and a discussion section in which students will interactively discuss how to incorporate these theories into their own practice as architectural professionals. Understanding and proposing various "spatial" needs associated with the diversification of lifestyles has become an important aspect of architectural planning and design in today's society. This lecture is intended to be taken prior to the internship training, students can acquire various theories on space and methodologies for concrete proposals, which will make their practical experience in the internship more effective.

Numerical Analysis of Indoor and Outdoor Environment 2 credits

Elective Required

Associate Professor Tomonobu Goto

Assistant Professor Yasuyuki Ishida

An introduction is given to CFD simulations of airflow—related phenomena in and around buildings using various turbulence models, namely standard and revised k-e models, ASM, DSM and LES. Canopy flow models for reproducing aerodynamic effects of flow obstacles whose sizes are smaller than computational grid cell is also introduced.
Emphasis is placed on the performance of these models and the essentials of modelling techniques when they are applied to complex flow fields related to the built environment.
Furthermore, the way how the turbulent flow simulations can be utilized for environmental design is also provided.

Design of Building Facilities 2 credits

Elective Required

Professor Hikaru Kobayashi

Based on the knowledge of environmental engineering and building equipment acquired so far, develop practical design and application skills for air conditioning, plumbing, and sanitary equipment. In air conditioning design, the heat source system is studied by calculating the air conditioning load, the air conditioner's capacity is determined using the psychrometric chart, and air conditioning systems are designed. In addition, design the water piping and air ducting systems. In sanitary system design, the water supply and drainage loads are determined, and the actual building's water supply and drainage systems are designed. Grades will be evaluated comprehensively based on reports and questions during lectures.

Indoor Climate Design for Human Occupancy 2 credits

Elective Required

Associate Professor Tomonobu Goto

Environmental quality is a very important issue for the success or failure of architecture. This course is to learn as follows. (1) How built environments affect occupants (especially, relationships between indoor climate and air quality to occupants' health, comfort and productivity), (2) Evaluation indices of built environments, and measuring methods of required physical quantities for the evaluation, and (3) Measures to improve built environments based on (1) and (2).

Performance Control of Building Structure 2 credits
Elective Required
Professor Masaki Maeda

This lecture discusses the basic theory for realizing buildings that make effective use of limited resources, minimize the burden on the global environment, and possess the necessary structural performance, including functionality, repairability, and safety under various loads and external forces.
Specifically, the lecture will cover performance evaluation design methods for new buildings, seismic diagnosis and seismic retrofitting of existing buildings, and the sustainable design of buildings for various loads, mainly earthquakes.

Technology for Optimum Mitigation 2 credits
Elective Required
Professor Kohju Ikago

Earthquake protection is an important aspect of building design in Japan. In view of the recent earthquake damage, it has become important to protect not only human lives but also property in the event of a major earthquake. In this course, the basic concepts of vibration theory and structural control theory, which are the basis of seismic design, will be presented. The fundamentals of mathematical programming, which are necessary to understand the optimal control theory, are also explained. Furthermore, the concepts, design methods, and applications of vibration control of structures and seismic isolation structures, which are attracting attention as design methods to control building damage, will be discussed.

Earthquake Disaster Control 2 credits
Elective Required
Associate Professor Susumu Ohno

This lecture discusses basic issues related to the seismic design of structures and seismic safety of cities in relation to the geological environment based on ground motion theory. For the seismic design of structures, the amplification characteristics of seismic motions from the engineering bedrock to the ground surface and the seismic load evaluation method considering the dynamic interaction between structures and the ground are described. In addition, the concept of earthquake disaster prevention measures that are consistent with the seismic, geological, and social environments is discussed.

Reliability Engineering 2 credits
Elective Required
Professor Kohju Ikago

Structural design practice for buildings in Japan is shifting from the conventional deterministic "allowable stress design method" to the probabilistic method represented by the "limit state design method. In other words, it is required to quantitatively evaluate the usability and safety of structures against external forces such as earthquakes, strong winds, and heavy snowfall. Since there are various uncertainties in the loads as well as bearing capacity of structures, it is necessary to evaluate them rationally and model them appropriately. In this lecture, the fundamentals and applications of probability theory, random vibration theory, and reliability theory and their application to structural design criteria will be discussed. Exercises using simple examples will also be given.

Theoretical Basis of Mathematics and Dynamics in Building Engineering I 1 credit
Elective Required
Professor Masaki Maeda
Associate Professor Susumu Ohno

The basics of vibration theory, ground motion, and seismic response analysis as the basic components of seismic design are discussed with the practical exercises. Students will acquire the minimum required knowledge and skills to conduct the seismic design when the students will take structural design internship.

Theoretical Basis of Mathematics and Dynamics in Building Engineering II 2 credits
Elective Required
Associate Professor Tomonobu Goto
Assistant Professor Yasuyuki Ishida

This course is to learn some fundamental techniques on heat and mass transfer simulations that are carried out at each stage of built environment design and to conduct some exercises of practical issues. This course comprises lectures on dynamic heat load simulation, thermal network simulation, and heat transfer analysis by finite volume method. Students will get the knowledge and skills to conduct the simulations properly.

Development of Applied Computer System in Architecture I 2 credits
Elective Required
Associate Professor Susumu Ohno
Associate Professor Noriyuki Takahashi

Based on the knowledge from "Theoretical Basis of Mathematics and Dynamics in Building Engineering I", students will learn the principles of simulation and practice in practical issues through the creation of computer programs. To acquire the knowledge and skills necessary for structural design and evaluation of structural performance.

Urban and Architectural Design I 4 credits
Elective Required
Professor Yasuaki Onoda
Professor Taro Igarashi
Professor Osamu Murao
Professor Aya Kubota
Associate Professor Masashige Motoe
Associate Professor Haruka Tsukuda
Associate Professor Takashi Fujino
Assistant Professor Koji Ichikawa
Research Associate Erika Imaizumi

While the urban and architectural theories in each course are for analysis and awareness, it is necessary to engage with existing cities and architecture through practice. In this class, students are expected to work individually or in groups to make new proposals through concrete designs to the present state of urban and architectural design.

Urban and Architectural Design II 4 credits

Elective Required

Professor Yasuaki Onoda
Professor Taro Igarashi
Professor Osamu Murao
Professor Aya Kubota
Associate Professor Masashige Motoe
Associate Professor Haruka Tsukuda
Associate Professor Takashi Fujino
Assistant Professor Koji Ichikawa
Research Associate Erika Imaizumi
Part-time Lecturer Hitoshi Abe

While the urban and architectural theories in each course are for analysis and awareness, it is necessary to engage with existing cities and architecture through practice. In this course, students are expected to make new proposals through concrete designs for the present state of cities and architecture, either individually or in groups.

Urban and Architectural Design Theory 2 credits

Elective Required

Professor Taro Igarashi

Deep thinking creates outstanding design. This causal relation will also bring about new criticism. This lecture will deal genealogy of architecture and urbanism theory, then consider current condition. Specific theme of lecture will be changed in each semester. Result will be judged on number of days one has attended, a paper at the end of semester, oral presentation and discussion about theme.

Architectural IT Communication Design 2 credits

Elective Required

Associate Professor Masashige Motoe

The lecture will present several contemporary examples of IT communication design and the technologies that support them, and discuss how information technology can influence, change, and expand the possibilities of architectural and urban spaces. The purpose of this lecture is to provide a foundation for the development of design skills necessary in the age of the fusion of information and space.

Project Design 2 credits

Elective Required

Associate Professor Takashi Fujino

Contemporary urban and architectural design requires techniques that go beyond the conventional scope of simply dealing with hardware to combine various technologies and situate them within society. In this lecture, examples of such urban and architectural projects will be explained and methods of designing projects will be discussed.

The World's Architectural Heritage 2 credits

Elective Required

Associate Professor Junichiro Higaya

In this lecture, several classic books on the history of Western architecture (mainly in Western languages, but including some translated into Japanese) will be introduced, after which the presenter will select one book each and give a commentary. It is acceptable if you are not good at Western languages other than English, but please look up the names of related places, buildings, people and other technical terms before the presentation. It is advisable to take this course together with the 'History of Architecture'.

Architectural Programming for the Public 2 credits

Elective Required

Professor Yasuaki Onoda

Associate Professor Haruka Tsukuda

It is clear that questioning the meaning of "public" in our society is an extremely important task for architectural professionals. In fact, architecture that sincerely addresses the question of "public" has been born. In this class, we will read literature discussing "public" and analyze and discuss actual public buildings as subjects. Through these activities, we will explore the meaning of "public" in contemporary architecture. The analysis will be conducted in teams of several students.

Sustainable Building 2 credits

Elective Required

Professor Hikaru Kobayashi

Professor Natsuko Nagasawa

In this lecture, the technical topics, including building thermal performance, energy conservation laws, zero energy building, building control and monitoring, energy management, etc., considered to be essential in planning sustainable buildings are discussed. Grades will be evaluated comprehensively based on reports and questions during lectures.

Assessment of Environmental Performance of Buildings 2 credits

Elective Required

Professor Hikaru Kobayashi

Professor Natsuko Nagasawa

Assistant Professor Yasuyuki Ishida

Part-time Lecturer Toshiharu Ikaga

This course is designed to provide students in the fields of building design and built environment engineering with guidance and experience in assessment of environmental performance of buildings and building design to improve the built environment efficiency. In addition, environmental design examples in Japan and overseas is introduced.

Students evaluate the environmental performance of buildings designed in the past, and are encouraged to understand various environment-conscious techniques, the limitations, and the effective application method.

Lifetime Engineering 2 credits
Elective Required
Associate Professor Tomoya Nishiwaki

Building design should consider not only safety, function, and construction cost but also sustainability and environmental impact over the entire life cycle of a building, including appropriate maintenance, reuse, and demolition. In this lecture, the environmental aspects of various building materials will be introduced. And some related journal papers will be discussed. Each student should give their presentation(s) of their research and associated environmental issues.

Methodology on New Materials based Structural System 2 credits
Elective Required
Professor Yoshihiro Kimura
Part-time Lecturer Toshiaki Someya

Earthquake-resistant structures in Japan have been established based on lessons learned from earthquake disasters. In this lecture, the historical background of the establishment of the current design and construction of building structures will be outlined, and the social needs and processes of new materials and new construction methods developed to date will be discussed, as well as the problems that have been identified since then. The lecture will also discuss the performance and damage mechanisms of the new materials and methods currently under development, and how the performance design methods for building structures with these materials and methods can be applied.

Adaptive Design of Buildings 2 credits
Elective Required
Associate Professor Noriyuki Takahashi

Since the introduction of the performance-based seismic design, it has become necessary to specify the seismic performance that a building should exhibit toward earthquake. The performance should be selected by stakeholders. Therefore, it is a skill required for engineers/designers to make the specified seismic performance understandable to stakeholders. This lecture introduces the designer's efforts to translate the protocols used in seismic design into expressions that can be understood by the building owner. The latest efforts in performance design methods for building structures adapted to the requirements of stakeholders will also be discussed.

Urban Seismic Risk 1 credit
Elective Required
Part-time Lecturer Kazuya Mitsuji

State-of-the-art knowledge is explained on foundation design and dynamic soil-structure interaction based on the theory, experiment, and observation results. As the foundation is boundary between soil and upper structure, soil mechanics and soil dynamics, especially related to the building foundation, are also included in the class. Topics below are scheduled in the class; 1) Engineering properties of soil, 2) Consolidation settlement and liquefaction, 3) Spread foundation design, 4) Pile foundation design, 5) Wave propagation in ground and dynamic soil-structure interaction.

Crisis & Risk Management for Disaster Mitigation 2 credits
Elective Required
Professor Takeshi Sato
Associate Professor Akihiro Shibayama
Part-time Lecturer Tatsuya Fujioka

Japan's social issue of risk management and crisis management based on lessons from Great East Japan Earthquake 2011 will be introduced. The main keywords are school safety, campus safety, maintaining hospital functions, prefectural logistics base and human security etc. And also, the latest information technology for disaster risk reduction will be discussed with students. Through this lecture, students will be able to utilize early warning and natural hazard information.

Development of Applied Computer System in Architecture II 2 credits
Elective Required
Associate Professor Tomonobu Goto
Assistant Professor Yasuyuki Ishida

This is the advanced course succeeding "Theoretical Basis of Mathematics and Dynamics in Building Engineering II". In this course, students learn about the basis of numerical analysis methods for solving heat conduction equation and Navier-Stokes equations, and the basis of computer program to solve heat conduction equation. Students also perform a parametric study on a practical building issue. By doing these exercises, students understand the effects of various factors relating to built environments and develop their fundamental knowledge for advanced design of built environments and facilities.

Special Lecture for Master Course in Architecture and Building Science 2 credits
Elective Required
All faculty

It is special lecture about creation and development of learning for the latest academic research in particular field and related fields.

Experiments of Building Structures 2 credits
Elective Required
All faculty

By designing models and scale models of members, joints, and partial frames that simulate actual structures, creating drawings of test bodies and models, ordering, manufacturing management, and conducting various experiments such as performance confirmation experiments, structures, experience the response and breaking behavior of the model, and learn important matters in structural design and construction management.

Exercise in Environmental Engineering and HVAC System Design 2 credits
Elective Required
All faculty

In this lecture, through the measurement and simulation of the thermal environment inside and outside the building and energy consumption, acquire the influence of facility design on the actual living environment and energy consumption, and cultivate application skills.

Internship Training A1 1 credit
Elective Required
All faculty

We conduct practical training on architectural design, structure design, equipment design and construction supervision at domestic, overseas companies and design offices. Through this seminar, we actually experience and understand how to proceed with practical work and group work on programing, planning, designing, construction, post-hiring training etc. Trainees submit training plans and training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training.

Internship Training A2 1 credit
Elective Required
All faculty

We conduct practical training on architectural design, structure design, equipment design and construction supervision at domestic, overseas companies and design offices. Through this seminar, we actually experience and understand how to proceed with practical work and group work on programing, planning, designing, construction, post-hiring training etc. Trainees submit training plans and training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training.

Internship Training A3 1 credit
Elective Required
All faculty

We conduct practical training on architectural design, structure design, equipment design and construction supervision at domestic, overseas companies and design offices. Through this seminar, we actually experience and understand how to proceed with practical work and group work on programing, planning, designing, construction, post-hiring training etc. Trainees submit training plans and training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training.

Internship Training A4 1 credit
Elective Required
All faculty

We conduct practical training on architectural design, structure design, equipment design and construction supervision at domestic, overseas companies and design offices. Through this seminar, we actually experience and understand how to proceed with practical work and group work on programing, planning, designing, construction, post-hiring training etc. Trainees submit training plans and training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training.

Internship Training A5 1 credit
Elective Required
All faculty

For the purpose of cultivating a variety of practical abilities, conduct a more advanced training on architectural design and construction supervision at training sites different from training A1 to A4. Trainees submit training plans and training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training.

Internship Training A6 1 credit
Elective Required
All faculty

For the purpose of cultivating a variety of practical abilities, conduct a more advanced training on architectural design and construction supervision at training sites different from training A1 to A4. Trainees submit training plans and training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training.

Extramural Practice 1-4 credits
Elective Required
All faculty

Practice at domestic or overseas research institutions and consultancy companies. Through this seminar, understand the practical work such as R & D as the foundation of design and consulting work of individual projects, and the relationship between these tasks and design. Trainees submit training reports to training staff and academic advisors. Training time will be approved for one credit per 30 hours or more of training. Depending on the training time, the credit number is determined according to the following criteria with an upper limit of 4 credits.
(1) When training over 30 hours 1 credit
(2) When training over 60 hours 2 credits
(3) When training over 90 hours 3 credits
(4) When training over 120 hours or more 4 credits

In recent years, due to the increase of natural disasters and the emergence of global environmental problems, etc., it is required to consider various factors which have not been present in structural design, environment and equipment design. It is required that structural and environmental / equipment students who take internship training A1 to A4 also experience R & D and consulting practices that form the basis of advanced structural design and environmental / equipment design.

Seminar on Architecture and Urban Design 2 credits
Elective Required
Professor Taro Igarashi
Professor Aya Kubota
Associate Professor Masashige Motoe
Associate Professor Takashi Fujino

For students belong to group of architecture and urban design, having through a discussion based on academic materials of domestic and foreign researches, collection and organization documents, understanding of the theme will be trained with practical assignment.

Seminar on Architecture and Urban Planning 2 credits
Elective Required
Professor Yasuaki Onoda
Professor Michio Ubaura
Professor Osamu Murao
Associate Professor Junichiro Higaya
Associate Professor Shunichi Nomura
Associate Professor Haruka Tsukuda

For students belong to group of architecture and urban planning, having through a discussion based on academic materials of domestic and foreign researches, collection and organization documents, understanding of the theme will be trained with practical assignment.

Seminar on Sustainable Architecture and Building Science 2 credits
Elective Required
Professor Hikaru Kobayashi
Professor Natsuko Nagasawa
Associate Professor Tomoya Nishiwaki
Associate Professor Tomonobu Goto

The objective of this course is to gain basic ability to carry out research on the topics related to sustainable built environment. Students are required to review previous papers in the field of interest. Based on the reviews, students will provide their research plans.

Seminar on Structural Engineering for Architecture 2 credits
Elective Required
Professor Masaki Maeda
Professor Yoshihiro Kimura
Professor Takeshi Sato
Professor Kohju Ikago
Associate Professor Susumu Ohno
Associate Professor Noriyuki Takahashi
Associate Professor Akihiro Shibayama
Part-time Lecturer Kazuya Mitsuji
Part-time Lecturer Tatsuya Fujioka

Exercises such as introducing domestic and foreign literature based on the latest themes related to architectural structural engineering, collecting and organizing materials, workshops, discussions based on reports, etc., and summarizing ideas on the themes.

Research for Master's Thesis in Architecture and Building Science 8 credits
Elective Required
All faculty

For students belong to group of architecture and urban design, architecture and urban planning, sustainable architecture and building science, and structural engineering for architecture, having introduce of textbooks, documents, the experiments and practical assignments based on master's thesis theme and discussion through research will be required.

Design for Master's Thesis in Architecture and Building Science 8 credits
Elective Required
All faculty

Master's design needs to pass the following examination.
(1) Portfolio and Proposal Screening
(2) Middle Examination
(3) Submit for first examination (Layout, Plan, Elevation, Section, Section detail, Various details)
(4) Technical Research by outside experts and Professors of university.
(5) Submit for final defense (Final drawings, Photos of Architectural Model, Perspective drawings, Thesis about social implication of the project and summary results of various research.)
(6) Final defense
Middle and Final examinations are judged by invited appointed architects from outside university as well as professors.

Professors and appointed architects will provide support in order to learn deeper practice of architecture contents and techniques mastered through internship training.

授業科目表（MC）Opening of a course class subject list

Department of Management Science and Technology

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
専門基盤科目 Major Basic Subjects	技術戦略論 Technology Strategy	隔年 Every Other Year	J		2		左記の専門基盤科目，特別講義A， C及び特別研修Aのうちから，10 単位以上を選択履修すること。 At least 10 credits must be selected from the Major Basic Subjects, Advanced Topics A and C, and Group Studies A, listed on the left.
	イノベーションとアントレプレナーシップの経済学入門 A Introduction to Economics of Innovation and Entrepreneurship A	毎年 Every Year	E		2		
	アントレプレナーシップの経済学 A Economics of Entrepreneurship A	毎年 Every Year	E		2		
	イノベーション政策 A Innovation Policy A	隔年 Every Other Year	E		2		
	特許戦略の経済学 A Economics of Patent Strategy A	隔年 Every Other Year	E		2		
	経営システム論 Management Systems	毎年 Every Year	J		2		
	知的財産戦略 Intellectual Property Strategy	毎年 Every Year	J		1		
	プロジェクト・リーダーシップ Project Leadership	毎年 Every Year	J		2		
	価値システム Value Systems	毎年 Every Year	J		2		
	新事業創造論 New Business Creation	毎年 Every Year	J		2		
	リスク評価・管理学論 Risk Assessment and Management	毎年 Every Year	JE		2		
	安全マネジメント論 Safety Management	毎年 Every Year	J		2		
	科学技術コミュニケーション論 Science Communication	毎年 Every Year	J		2		
	技術社会システム概論 Introduction to Management Science and Technology	毎年 Every Year	J		2		
	経営計画 Business Planning	毎年 Every Year	J		2		
	カーボンニュートラル基礎論 Carbon Neutral Fundamentals	毎年 Every Year	JE		2		
	価値創造工学論 Value Creation Engineering	隔年 Every Other Year	JE		2		
	交通社会システム論 Management of Transportation Networks in Social Systems	毎年 Every Year	J		2		
	情報感性工学 Information Affective Engineering	毎年 Every Year	J		2		
	エネルギー変換制御機器工学 Electrical Energy Conversion and Control Equipment Engineering	毎年 Every Year	J		2		

	技術適応計画論 Management of Integrated System Technology	毎年 Every Year	J		2		
専門科目 Major General Subjects	インターンシップ研修 Internship Training				1		
	技術社会システム特別講義A Advanced Topics in MS&T A				2		
	技術社会システム特別講義 C Advanced Topics in MS&T C				2		
	ソーシャルシステムデザイン特別研修 A Group Studies in Social System Design A				2		
	バリュープロポジション特別研修 A Group Studies in Value Proposition A				2		
専門科目 Major General Subjects	ソーシャルシステムデザインセミナー Seminars in Social System Design	毎年 Every Year	J		2		左記のセミナーのうちから，２単位以上選択履修すること。 At least 2 credits must be selected from the Seminars on the left.
	バリュープロポジションセミナー Seminars in Value Proposition	毎年 Every Year	J		2		
	技術社会システム修士研修 Master Thesis Research in Management Science and Technology			8			
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						

1，上記科目の単位数を合わせて 30 単位以上を修得すること。
Students must acquire 30 or more credits from the subjects above.
2,『開講時期』については，現時点におけるものであり，変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

技術戦略論 2 credits

Technology Strategy
Elective Required
Professor Shuichi Ishida

21 世紀においては，先端科学技術を活用してイノベーションを創出し，新産業を創生することにより人類社会への貢献が求められている。このため，イノベーションの主たる担い手である企業は，国際的な競争力の基盤形成や社会問題解決に向けて効果的な技術政策・技術戦略を策定し，実施することが極めて重要である。
本講義では，企業が技術政策・技術戦略を策定するにあたって，経営戦略を踏まえて市場，科学技術，社会及び経済の課題及び動向を把握分析し，体系的，科学的に課題解決の処方を見出すため，標準化戦略も含めた企業における技術政策・技術戦略の策定・実施について理解させる。
This session examines the concept of technological strategy, which is necessary for considering innovation in business management. Case studies focusing on various industries will also be presented. The aim is to provide a comprehensive introduction to the theory and case studies of innovation management-based technology strategy.

イノベーションとアントレプレナーシップの経済学入門A 2 credits

Introduction to Economics of Innovation and Entrepreneurship A
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about historical aspects of innovation and entrepreneurship. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

アントレプレナーシップの経済学A 2 credits

Economics of Entrepreneurship A
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about theoretical aspects of innovation and entrepreneurship. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

イノベーション政策A 2 credits

Innovation Policy A
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about theoretical framework for industrial innovation and a broad range of public policies to promote innovation. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied..

特許戦略の経済学A 2 credits

Economics of Patent Strategy A
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about theoretical framework for economic incentives and consequences of patent strategies. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

経営システム論 2 credits

Management Systems
Elective Required
Professor Akira Nagamatsu

先端技術を効果的に活用して新規事業を構想し，実施するために必要な技術戦略の構築，経営戦略と技術戦略の統合，事業領域，事業機会と技術開発マネジメント，技術とマーケティングによる事業創造，戦略的提携，資本戦略，税務財務戦略，ファイナンス理論，標準化戦略を講義する。また，先端技術を具体的に事業化するための新規事業計画の作成手法，その評価方法について事例に基づいて理解させる。
Companies are required to conceptualize and implement new businesses by utilizing advanced technologies. To solve this problem, this lecture explains the "construction of technology strategy," "integration of management strategy and technology strategy," and "business areas. In addition, the lecture will explain how to create and evaluate a plan for commercialization of advanced technology based on case studies.

知的財産戦略 1 credits

Intellectual Property Strategy
Elective Required
Professor Shuichi Ishida

特許権や実用新案権など， 法律で規定された権利や法律上保護される利益に係る権利として保護される知的財産の基本的な考え方について具体的な事例を交え体系的に学ぶ。講義は２日間の集中講義で行われるため別途講義日程の案内に注目していただきたい。
Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.

プロジェクト・リーダーシップ 2 credits

Project Leadership
Elective Required
Professor Shuichi Ishida

本講義では，プロジェクトを構成する各活動の計画立案，日程表の作成，および進捗管理などが，計画（Plan），実行（Do），チェック（Check），是正（Action）という管理サイクル（PDCA サイクル）について解説する。全般的に経営戦略の考え方に基づき講義する。
In this lecture, the management cycle (PDCA cycle) of Plan, Do, Check and Action is explained, which includes planning, scheduling and progress management of the activities that make up the project. The lecture is based on the concept of management strategy in the broader context.

価値システム 2 credits

Value Systems

Elective Required

Professor Akira Nagamatsu

イノベーション創出での重要課題である「魔の川」「死の谷」「ダーウィンの海」などのマネジメント上の問題や企業内部における研究部門，開発部門および事業部門との間の技術成果から製品を上市するまでの障害を有効に解決する手法や評価を講義する。また，ロードマッピング，イノベーション・ポートフォリオマネジメント，イノベーションのアイデア創出，シナリオプランニング，イノベーション・プロジェクトの経済的評価を講義する。併せて，イノベーション組織や風土の再構築についても，オープン・イノベーションの議論も踏まえて講義する。新興国におけるイノベーション・マネジメントについても講義する。

This course covers management issues in innovation creation and methods to solve obstacles from technological results to product launch.

The restructuring of innovation organization and culture and innovation management in emerging countries will also be discussed.

新事業創造論 2 credits

New Business Creation

Elective Required

Professor Shuichi Ishida

経営学を基礎とした事業創造論について理論と事例の両面から学ぶ。領域は経営戦略のみならず，アントレプレナーシップ論にまで及ぶ。経営学を学んだことのない工学系院生が受講できるよう配慮している。

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

リスク評価・管理学論 2 credits

Risk Assessment and Management

Elective Required

Professor Makoto Takahashi

Associate Professor Daisuke Karikawa

科学技術の社会的受容を決める大きな要素の一つとしてその技術システムのリスクの問題があげられる。本講義では人間を含む大規模・複雑システムのリスクに関して，以下に示す多面的な内容について論じる。

(1) リスク評価の方法
(2) 事例を用いた事故過程のモデル化
(3) システム工学的アプローチによるリスク管理
(4) 確率論的安全評価
(5) 人間信頼性評価
(6) 原子炉プラントの安全性

(6) 原子炉プラントの安全性においては PC 版の原子炉シミュレータを用いて，原子力プラントの安全システムに関して実践的な理解を深めるための実習を行う予定である。

One of the significant factors determining the social acceptance of science and technology is the risk in technological systems. In this lecture, the following multifaceted topics about the risk of large-scale and complex systems, including human systems, will be discussed.

(1) Methods of risk assessment
(2) Modeling of accident processes using case studies
(3) Systems engineering approach to risk management
(4) Probabilistic safety assessment
(5) Human reliability assessment
(6) Safety of Nuclear Power Plant

In (6) Safety of Nuclear Power Plant, a PC version of the simulator will be used for practical training to deepen the practical understanding of nuclear plant safety systems.

安全マネジメント論 2 credits

Safety Management

Elective Required

Associate Professor Daisuke Karikawa

大規模・複雑システムの安全かつ安定的なオペレーションを実現する上で，人的要因が関わる事故の防止が重要な課題となっている。本講義では，人間の認知モデルやヒューマンエラーの発生メカニズム等の認知工学の基礎を学ぶと共に，ヒューマンエラーに起因する事故を防止するためのチームと組織のマネジメント手法について，実践事例を交えながら解説する。

For achieving the higher level of safety of large-scale complex systems such as aviation systems, nuclear power plants, and chemical plants, it is a key issue to prevent accidents caused by human errors. The aim of this course is to understand the basis of theory and application of safety management through studying the following topics:

- cognitive systems engineering, including human modelling, the taxonomy of human errors, and human-machine interface
- accident analysis methods
- non-technical skills for error management
- resilience engineering and high reliability organizations

科学技術コミュニケーション論 2 credits **Science Communication** Elective Required Professor Makoto Takahashi Associate Professor Daisuke Karikawa 本講義では工学系研究者として知っておくべき技術者倫理の基礎と，科学技術コミュニケーションの基礎を，実践的な講義を通じて学ぶ。技術者倫理と科学技術コミュニケーションに共通することは，工学を志す人がともすると忘れてしまいがちな社会との関わりという視点である。本講義では基礎的な講義の後，外部講師による多彩なケーススタディーを通じて，今後の社会との関わりにおいて技術者・科学者として重要な能力となる技術倫理に関する判断能力，立場・文化の異なる人達との対話能力，そして科学技術が関わる組織のマネジメントの基礎を身につけることが出来る。 The purpose of this lecture is to understand the basics of engineering ethics and science communication.The common issue in engineering ethics and science communication is the consideration of the relationship to society, in which technology would be utilized. When the advanced technology is introduced into society, possible influences are not only positive ones but negative effect might exist. The engineers should be aware of such negative influences of technology and of the importance of communication and corporate responsibility. In this lecture, the emphasis would be set on the engineering ethics and science communication, which are importance as scientist or engineers.	技術社会システム概論 2 credits **Introduction to Management Science and Technology** Elective Required Prof. Toshihiko Nakata Prof. Makoto Takahashi Prof. Kenji Nakamura Prof. Shuichi Ishida Prof. Akira Nagamatsu Assoc. Prof. Nobuya Fukugawa Assoc. Prof. Takeshi Nagae Assoc. Prof. Daisuke Karikawa 工学部で研究・技術を学んで社会に出た時に，現実の社会でより一層活躍するためには工学的専門知識だけでは不十分です。工学部で学ぶ理系的な知恵に加えて，ビジネスモデル，知的財産に関する知識や，グループをまとめ具体的な物作りへ繋げていくマネジメント力も非常に有用です。本講義では，自分の専門分野を社会にどのように役立てるかという視点を軸に，社会に出てから必要な付加価値を身に付けるための講義を行います。言い換えれば，社会的ニーズを背景に，工学を実践的なビジネスに結びつけるための基礎を学びます。 While studying engineering research in the Faculty of Engineering and Graduate School of Engineering, it is helpful to look at society and take a broad view of technology. The situation surrounding the industries that the engineering field has supported is changing. The areas of activity of those who have studied engineering at university are also very different from those of the past, with unimaginable changes expected in the future. This lecture aims to expose engineering students from a wide range of majors to various ideas about the relationship between technology and society. Specifically, teachers related to the Department of Technological and Social Systems will give lectures in an omnibus format in the light of their respective research fields, not only in their specialised areas but also on the links with society.
経営計画 2 credits **Business Planning** Elective Required Professor Akira Nagamatsu 企業などの組織は、計画を作成し、それを実行することで活動を行っている。そこで本講義では、企業の中長期の経営計画や単年度計画（予算）の構造を解説し、バランススコアカードや方針管理など関連手法や経営シミュレーションについても説明する。 Organizations such as companies engage in activities by creating and implementing plans. Therefore, in this lecture, we will explain the structure of medium to long-term business plans and annual plans for companies. We will also discuss related methods such as the Balanced scorecard, Hoshin Kanri, and business simulations.	カーボンニュートラル基礎論 2 credits **Carbon Neutral Fundamentals** Elective Required Professor Toshihiko Nakata 気候変動の解決方策としてのカーボンニュートラルの基礎を，現状のエネルギーシステム分析，シナリオモデリング，再生可能エネルギーの技術イノベーションの観点から習得する。 The class focuses on the fundamentals of carbon neutrality as a solution to climate change from the perspectives of current energy system analysis, scenario modeling, and renewables technological innovation.
価値創造工学論 2 credits **Value Creation Engineering** Elective Required Professor Hirokazu Moriya 本講義では，企業等の財務諸表を分析し，諸表上の数値や有価証券報告書情報，その他各種公開データから企業の価値創造戦略をひも解き，社会価値創造の本質や価値を捉える力をつける．また，実企業を対象として，財務諸表的な考え方に基づいて新事業の立案を行う．世界の動きを俯瞰する力，社会の変化を各種データに基づいて分析する力，事象の本質を把握する力，より良い社会にするためのコトづくりと新しい価値を生み出し社会に実装する力を，国内外機関の講師によるワークショップ等も交えながら養っていく． We will analyze financial statements of companies to unravel the value creation strategies using numerical data, information on the statements, and various publicly available data. The aim is to develop the ability to grasp the essence and value of social value creation. Additionally, the course involves formulating new business plans for real companies based on financial perspectives. Through workshops led by instructors from domestic and international universities and companies, students will cultivate skills such as the ability to overview global trends, analyze societal changes using various data, comprehend the essence of events, and contribute to creating a better society by generating new values and implementing them in society.	交通社会システム論 2 credits **Management of Transportation Networks in Social Systems** Elective Required Associate Professor Takeshi Nagae 道路・航空・港湾ネットワークを基盤とする社会システムを対象とし，混雑や環境破壊といった外部不経済に対し，市場による調整機能の長所と限界，およびその解決方法としての制度設計を解説する。その過程において，ミクロ経済学，交通工学，最適化理論などの諸理論を分野横断的に学習する。 In this course, students will understand fundamental theorem and mathematical techniques for analyzing transportation networks in social systems, including Microeconomics, Transportation Engineering and Mathematical Programming and so on.

情報感性工学 2 credits **Information Affective Engineering** Elective Required Professor Takahiro Ishinabe 情報ディスプレイ技術は、人と情報とを繋ぐ私たちの社会に不可欠な光技術です。本講義では、各種の情報ディスプレイ技術の歴史、基本構成と動作原理、応用例や今後の展開について、また関連する部材技術について解説する。また、人が光をどのように感じ、情報として受け取るのかという人の認識や理解、感性と情報との関わりについても学ぶ。 Information display technology is an optical technology essential to our society that connects people to information. The aim of this course is to understand the history, basic structure, principle of operation, application examples, future development of information display technology including related materials. A human perception of light and a relationship between information and human cognition, understanding, and sensitivity will also be discussed.	エネルギー変換制御機器工学 2 credits **Electrical Energy Conversion and Control Equipment Engineering** Elective Required Professor Kenji Nakamura モータや発電機，トランスやリアクトル，インバータやコンバータなどに代表されるエネルギー変換制御機器は，効率の良いエネルギーの発生・輸送・変換・利用に不可欠なキーデバイスである。本講義では，各種エネルギー変換制御機器の歴史，基本構成と動作原理，応用例や今後の展開などについて理解するとともに，これらの機器の解析設計法についても学ぶ。 Electrical energy conversion and control equipment such as electric motors, generators, transformers, reactors, inverters, and converters are key devices for efficient generation, transportation, conversion, and utilization of electrical energy. In this course, students will understand the history, basic structure, principle of operation, application examples, future development of various energy conversion and control devices, and the analysis and design methods of these devices.
技術適応計画論 2 credits **Management of Integrated System Technology** Elective Required Professor Makoto Takahashi 少子高齢化や経済格差などの国レベルの巨大な問題，天災やパンデミックなどの予測できない事象，持続可能性や多様性の包摂，Z 世代への社会的移行などの学際的な議題…VUCA と呼ばれる何もかもが不確実な 21 世紀に工学者はどう向き合い，先進技術をどのように適用すべきだろうか？ 本講義はこの問いに対し，スペキュラティヴデザイン，トランジションデザインといった最新のデザイン手法を用いて，未来の社会像を想像・夢想により可視化し，そのビジョンから遡り先進技術の可能性や方向性を計画する，バックキャスティングの手法を演習型で学ぶ。事前知識・デザイン経験は不要。 Everything is uncertain in this century, called VUCA times. We face substantial complex issues, such as aging society, economic disparity, unpredictable natural disasters and pandemics, and more interdisciplinary matters like sustainability, diversity, and social transition to Generation Z. How should engineers tackle this ambiguity and apply advanced technology? This lecture aims to answer this question by imagining and dreaming visions of the future society through the latest design methods, such as Speculative Design and Transition Design. Students will learn the backcasting techniques to think back about the applicability of the technology from the future. No prior knowledge or design experience is required.	インターンシップ研修 1 credits **Internship Training** Elective Required All Faculty 実地研修として，企業にて実習，研究活動を行う。本専攻が研究対象とする技術－社会の境界問題，あるいはその解決のためのアプローチが実社会の中でどのように実装されているのかについて見聞を深めると共に，企業における計画，調査研究，製品開発，製造，品質管理などの実態，人のつながり，企業現場の雰囲気を実地に体験，理解する。 Students who intend to take internship unit (1 unit) conduct practical training and research activities at companies as on-the-job training. To deepen our understanding of the technology-social boundary problems that our department is studying, or how approaches to solve them are implemented in the real world, as well as planning, research, product development, etc. in companies. Experience and understand the actual conditions of manufacturing, quality control, connections between people, and the atmosphere of the company site.
技術社会システム特別講義A 2 credits **Advanced Topics in MS&T A** Elective Required All Faculty 専門分野に係わる学問の創造と発展に関する特別講義であり，個別の対象にケース・メソッド（事例研究）を導入して実務能力と応用力を涵養する。 This course provides special lectures on the specific domain concerning creation and development of science . The case method is introduced to help students acquire practical skills.	技術社会システム特別講義C 2 credits **Advanced Topics in MS&T C** Elective Required All Faculty 専門分野に係わる学問の創造と発展に関する特別講義であり，個別の対象にケース・メソッド（事例研究）を導入して実務能力と応用力を涵養する。 This course provides special lectures on the specific domain concerning creation and development of science . The case method is introduced to help students acquire practical skills.
ソーシャルシステムデザイン特別研修A 2 credits **Group Studies in Social System Design A** Elective Required All Faculty Members belonging to the Course ソーシャルシステムデザイン分野の学術研究および社会動向の変化を理解し，修士研究を進める上で基本となる研究の価値と社会実装手法を研鑽する。 In this course, students will understand the changes in academic research and social trends in the field of social system design, and study the value of research and social implementation methods that are fundamental to conducting master's research.	バリュープロポジション特別研修A 2 credits **Group Studies in Value Proposition A** Elective Required All Faculty Members belonging to the Course バリュープロポジション分野の学術研究および社会動向の変化を理解し，修士研究を進める上で基本となる研究の価値と社会実装手法を研鑽する。 In this course, students will understand the changes in academic research and social trends in the field of value proposition, and study the value of research and social implementation methods that are fundamental to conducting master's research.

ソーシャルシステムデザインセミナー 2 credits **Seminar in Social System Design** Elective Required All Faculty Members belonging to the Course ソーシャルシステムデザイン分野の学際的なテーマについて高度なグループ研究またはセミナーを行う。セミナーの基本となるテーマは，各学期の始めに設定される。 Advanced group research or seminars on interdisciplinary topics in the field of social systems design. The basic theme of the seminar will be set at the begining of each semester.	バリュープロポジションセミナー 2 credits **Seminars in Value Proposition** Elective Required All Faculty Members belonging to the Course バリュープロポジション分野の学際的なテーマについて高度なグループ研究またはセミナーを行う。セミナーの基本となるテーマは，各学期の始めに設定される。 Advanced group research or seminars on interdisciplinary topics in the field of value proposition. The basic theme of the seminar will be set at the beginning of each semester.
技術社会システム修士研修 8 credits **Master's Thesis Research in Management Science and Technology** Required All Faculty バリュープロポジション，ソーシャルシステムデザインの各グループにおいて，研究発表，討論，文献紹介などを含む実験および演習に参加する。 These seminars are reserved for students receiving guided research from supervisors. Students engage in experiments and seminars, as well as research presentations, discussions, and literature reviews.	

授業科目表（DC）List of Courses

Department of Mechanical Systems Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること．なお，特別講義Ｂと特別研修 B 及び関連科目で修得した単位は４単位まで本要件に含めることができる． A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	知的デザイン学特論 Advanced Intelligent Design		E		2		
	エネルギーシステム工学特論 Advanced Energy Systems Engineering		E		2		
	破壊機構学特論 Fracture Mechanics and Mechanisms	毎年 Every year	E		2		
	知能流体システム学特論 Intelligent Fluid Systems		E		2		
	機械システム保全学特論 Advanced Mechanical Systems Maintenance Engineering		E		2		
	多元物質応用システム工学特論 Multidisciplinary Research and Application of Solid-State Ionic Devices	隔年 Every second year	E		2		
	ナノテクノロジー特論 Advanced Nano/Technology		E		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology		E		2		
専門科目 Major General Subjects	機械機能創成特別講義Ｂ Special Lecture on Mechanical Systems Engineering B				1～4		
	機械機能創成特別研修Ｂ Advanced Seminar on Mechanical Systems Engineering B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	機械機能創成博士研修 Doctoral Thesis Research in Mechanical Systems and Engineering			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。（自専攻の学際基盤科目から 4 単位以上履修すること。ただし、特別講義Ｂ、特別研

修Ｂ及び他専攻・他研究科の関連科目の内から 4 単位以上を選択履修することもできる）

Students must acquire 16 or more credits from the subjects above. (Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department and can also select 4 or more credits from Special Lecture B, Advanced Seminar B and Related subjects of other departments or other schools.)

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits

Elective Required

Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits

Elective Required

Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits

Elective Required

Nano Magnetism and Magnetic Engineering 2 credits

Elective Required

Professor Daichi Chiba

Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Intelligent Design 2 credits

Elective Required

Professor Takahito Ono

Professor Masayoshi Mizutani

Nanotechnology-based nano-precision mechanical manufacturing and micro-nanomachining, and integration technologies of various components are lectured. Precision machines based on above technologies and micro-nanomachines, the design and modeling of those mechanical elements, recent research on applications to information technologies, energy, and medical fields are also lectured.

Advanced Energy Systems Engineering 2 credits

Elective Required

Professor Hiroo Yugami

Professor Tetsushi Biwa

Professor Masaya Shigeta

Associate Professor Makoto Shimizu

This course provides students with deep knowledge on the broad topics selected from energy conversion engineering and related fields, such as the control and application methods of heat and fluid energy, as well as renewable energy technology and thermoacoustics. Students will acquire the ability to find out the problems and to pursue the solutions through this lecture.

Fracture Mechanics and Mechanisms 2 credits

Elective Required

Professor Kazuhiro Ogawa

Associate Professor Yoichi Takeda

Although a fracture is a well-known phenomenon since early times, the unsolved problem has been left because of the diversity of the influential factors. Therefore, the elucidation of fracture mechanics and mechanisms are desired.

For the elucidation of fracture mechanics and mechanisms, it is necessary that understanding of the interaction and synergistic effect of the diversified influential factors.

In this lecture, fractures of the structures, which are induced by high-temperature oxidation and the environmental assisted cracking, are lectured. Moreover, examples of failure accidents in structures and materials are introduced, its suppression and prevention techniques are discussed.

Intelligent Fluid Systems 2 credits

Elective Required

Professor Kaoru Maruta

Professor Takehiko Sato

Professor Atsuki Komiya

Fundamentals and applications for intelligent control of thermo-fluid flows under the various conditions including microgravity and electro-magnetic field, and its optimized simulation method are discussed. The construction of intelligent fluid systems with sensing, processing, control and actuation and its applications to energy conversion, plasma medicine and material processing are discussed.

Prof. K. Maruta: Fundamental and applications of combustion dynamics

Prof. T. Sato: Plasma medicine and plasma flows

Prof. A. Komiya: Sensing and control of micro-nano scale thermos-fluid flows.

Advanced Mechanical Systems Maintenance Engineering 2 credits
Elective Required
Professor Tetsuya Uchimoto

Maintenance activities play an important role to secure the safety and long-life of various artifacts such as industrial plants, commercial aircrafts. Optimization of the maintenance activities in view of both system safety and economic performance is placed as a major key challenge. In this course, we outline recent progresses of disciplines composing maintenance engineering such as reliability engineering, risk evaluation, nondestructive testing, failure analysis, at first. In addition, we discuss the quantitative evaluation of reliability and risk for optimization of the maintenance activities such as inspection and repair.

Multidisciplinary Research and Application of Solid-State Ionic Devices 2 credits
Elective Required
Professor Koji Amezawa

In this lecture, topics related to basics and applications of ion transport phenomena in solids and on solid surface and/or interface are introduced and discussed from the viewpoints of materials chemistry and solid-state physics. More details, such as the style of the lecture, will be announced in the beginning of the semester.

Advanced Nano/Technology 2 credits
Elective Required
Professor Gao Wei
Professor Koshi Adachi

This course focuses on two main fields of nanotechnologies. The first field is tribology, which is the technical and scientific aspect of contact surface. Fundamental of tribology and tribological performance of the contact surface will be taught in the class. The second field is nanometrology, which is the science of measurement in the nanometric scale. The fundamental and systems of nanometrology based on optics will be introduced.

Advanced Bio-Nanotechnology 2 credits
Elective Required
Professor Matsuhiko Nishizawa
Professor Tetsu Tanaka
Associate Professor Takafumi Fukushima

Recent trends and perspective on Bio-nanotechnology, including the progress in micromachining techniques and LSI techniques, will be lectured in order to educate ability for engineering innovative devices for advanced medicines.

Special Lecture on Mechanical Systems Engineering B 1~4 credits
Elective Required

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Special Seminar on Mechanical Systems Engineering B 1~4 credits
Elective Required
Professor Shuichi Ishida

The problem-posing ability is acquired by integrating advanced expertise through the training.

Doctoral Thesis Research in Mechanical Systems and Engineering 8 credits
Required

Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.

授業科目表（DC）List of Courses

Department of Finemechanics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること．なお，特別講義 B と特別研修 B 及び関連科目で修得した単位は４単位まで本要件に含めることができる． A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	材料メカニクス特論 Advanced Mechanics of Materials	隔年 Every second year	E		2		
	ナノテクノロジー特論 Advanced Nano/Technology		E		2		
	ナノ流動学特論 Nano-Flow Science	隔年 Every second year	E		2		
	ソフトメカニクス特論 Advanced Soft Mechanics	隔年 Every second year	E		2		
	破壊機構学特論 Fracture Mechanics and Mechanisms	毎年 Every year	E		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology		E		2		
	バイオメカニクス特別講義Ⅱ Special Lecture Series on Integrated Biomechanics Ⅱ	３年ごと Every third year	E		2		
	知的メカノシステム工学特論 Intelligent Mechanosystem Engineering		E		2		
	表面ナノ・マイクロ計測制御学特論 Advanced Nano-and Micro-Surface Metrology and Engineering	隔年 Every second year	E		2		
専門科目 Major General Subjects	ファインメカニクス特別講義Ｂ Special Lecture on Finemechanics B				1～4		
	ファインメカニクス特別研修Ｂ Advanced Seminar on Finemechanics B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	ファインメカニクス博士研修 Doctoral Thesis Research in Finemechanics			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。（自専攻の学際基盤科目から 4 単位以上履修すること。ただし、特別講義Ｂ、特別研修Ｂ及び他専攻・他研究科の関連科目の内から 4 単位以上を選択履修することもできる）

Students must acquire 16 or more credits from the subjects above. (Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department and can also select 4 or more credits from Special Lecture B, Advanced Seminar B and Related subjects of other departments or other schools.)

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

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JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits
Elective Required
Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits
Elective Required
Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits
Elective Required

Nano Magnetism and Magnetic Engineering 2 credits
Elective Required
Professor Daichi Chiba
Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Mechanics of Materials 2 credits
Elective Required
Professor Hitoshi Soyama
Professor Hironori Tomyoh

Lecture will deal with methodological explorations about extension of lifetime and enhancement of strength of various materials systems from small systems such as IC packages to large mechanical components and structures, in order to use the systems at severe conditions and/or long time. Microscopic key factors of functional characteristics and performance of the systems are variety of atoms and molecules, their sequences in nanoscale and microstructure in meso-scale. On the basis of these factors, analysis of microscopic characteristics and effects of the microscopic characteristics on macroscopic characteristics will be reviewed including their measurement and evaluation methods, and some real examples will be described in the lecture.

Advanced Nano/Technology 2 credits
Elective Required
Professor Gao Wei
Professor Koshi Adachi

This course focuses on two main fields of nanotechnologies. The first field is tribology, which is the technical and scientific aspect of contact surface. Fundamental of tribology and tribological performance of the contact surface will be taught in the class. The second field is nanometrology, which is the science of measurement in the nanometric scale. The fundamental and systems of nanometrology based on optics will be introduced.

Nano-Flow Science 2 credits
Elective Required
Professor Takahito Ono
Professor Takashi Tokumasu
Professor Kazuhiko Endo

To realize higher performance and lower energy consumption of advanced green nano-devices such as ULSI, TFT, MEMS/NEMS, sensors, optical devices, solar cells, secondary batteries, thermoelectric conversion devices, and so on, a process technology with atomic-layer-level control of device materials and structure is inevitable. Process technologies (such as etching, thin film deposition, surface modification) are basis of nanotechnology and are realized by utilization and control of plasma, beam, biomolecules, and so on. This

Advanced Soft Mechanics 2 credits
Elective Required
Professor Takeshi Yamaguchi

Soft materials such as polymers, rubbers, and gels are called "soft materials." They exhibit mechanical properties and functions different from those of hard materials such as metals and ceramics. In this lecture, mechanical and frictional properties of soft materials, including living body, will be discussed, and the fundamentals and advanced technologies of soft mechanics will be reviewed, including recent research, with applications in sports and medical and welfare fields as subjects.

course will introduce the principle of these nano-processes which is needed for research and development of green nano-devices. Examples of devices fabricated by these processes are also introduced.

Fracture Mechanics and Mechanisms 2 credits
Elective Required
Professor Kazuhiro Ogawa
Associate Professor Yoichi Takeda

Although a fracture is a well-known phenomenon since early times, the unsolved problem has been left because of the diversity of the influential factors. Therefore, the elucidation of fracture mechanics and mechanisms are desired.
For the elucidation of fracture mechanics and mechanisms, it is necessary that understanding of the interaction and synergistic effect of the diversified influential factors.
In this lecture, fractures of the structures, which are induced by high-temperature oxidation and the environmental assisted cracking, are lectured. Moreover, examples of failure accidents in structures and materials are introduced, its suppression and prevention techniques are discussed.

Advanced Bio-Nanotechnology 2 credits
Elective Required
Professor Matsuhiko Nishizawa
Professor Tetsu Tanaka
Associate Professor Takafumi Fukushima

Recent trends and perspective on Bio-nanotechnology, including the progress in micromachining techniques and LSI techniques, will be lectured in order to educate ability for engineering innovative devices for advanced medicines.

Special Lecture Series on Integrated Biomechanics II 2 credits
Elective Required
Professor Yoichi Haga
Professor Takuji Ishikawa
Professor Makoto Ohta
Professor Makoto Kanzaki

Understanding of living system and cell from the point of view of mechanical system. Understanding advanced research trends for the development of biology and medical applications. Modeling and analysis of living system from the point of view of mechanical system are lectured. Medical device development, design and analysis of the biological model, and functional analysis of the cell are lectured.

Intelligent Mechanosystem Engineering 2 credits
Elective Required
Professor Makoto Ohta
Associate Professor Kenichi Funamoto

To realize intelligent mechano-systems that autonomously adapt to their environment, it is essential to understand the structure and the mechanisms of sensing and decision-making of intelligent systems in living organisms. This lecture focuses on problems related to the fundamentals and applications of optimization of complex dynamic systems, and aims to develop an intuitive understanding of the most common methods of optimization theory by functional analysis.

Advanced Nano-and Micro-Surface Metrology and Engineering 2 credits
Elective Required
Professor Wataru Yashiro

Measurement and control are the two wheels of manufacturing. The aim of this lecture is to learn the most advanced measurement and control methods covering a wide range of spatial scales from atomic to macroscopic scales of surfaces and interfaces that govern the functions of materials. The ultimate goal of this course is to enable students to gain insight into the current state of measurement and control technology, its limitations, and the potential for opening up new frontiers in materials and life sciences.

Special Lecture on Finemechanics B 1~4 credits
Elective Required

A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.

Advanced Seminar on Finemechanics B 1~4 credits Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.	**Doctoral Thesis Research in Finemechanics** 8 credits Required Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.

授業科目表（DC）List of Courses

Department of Robotics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること．なお，特別講義Ｂと特別研修 B 及び関連科目で修得した単位は４単位まで本要件に含めることができる． A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	バイオナノテクノロジー特論 Advanced Bio-Nanotechnology		E		2		
	バイオメカニクス特別講義Ⅱ Special Lecture Series on Integrated Biomechanics Ⅱ	３年ごと Every third year	E		2		
	ロボティクス特論 Advanced Robotics	隔年 Every second year	E		2		
	知的メカノシステム工学特論 Intelligent Mechanosystem Engineering		E		2		
	知的デザイン学特論 Advanced Intelligent Design		E		2		
	ナノテクノロジー特論 Advanced Nano/Technology		E		2		
専門科目 Major General Subjects	ロボティクス特別講義Ｂ Special Lecture on Robotics B				1～4		
	ロボティクス特別研修Ｂ Advanced Seminar on Robotics B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	ロボティクス博士研修 Doctoral Thesis Research in Robotics			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。（自専攻の学際基盤科目から 4 単位以上履修すること。ただし、特別講義Ｂ、特別研修Ｂ及び他専攻・他研究科の関連科目の内から 4 単位以上を選択履修することもできる）

Students must acquire 16 or more credits from the subjects above. (Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department and can also select 4 or more credits from Special Lecture B, Advanced Seminar B and Related subjects of other departments or other schools.)

2，『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

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JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits
Elective Required
Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits
Elective Required
Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits
Elective Required

Nano Magnetism and Magnetic Engineering 2 credits
Elective Required
Professor Daichi Chiba
Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Bio-Nanotechnology 2 credits
Elective Required
Professor Matsuhiko Nishizawa
Professor Tetsu Tanaka
Associate Professor Takafumi Fukushima

Recent trends and perspective on Bio-nanotechnology, including the progress in micromachining techniques and LSI techniques, will be lectured in order to educate ability for engineering innovative devices for advanced medicines.

Special Lecture Series on Integrated Biomechanics II 2 credits
Elective Required
Professor Yoichi Haga
Professor Takuji Ishikawa
Professor Makoto Ohta
Professor Makoto Kanzaki

Understanding of living system and cell from the point of view of mechanical system. Understanding advanced research trends for the development of biology and medical applications. Modeling and analysis of living system from the point of view of mechanical system are lectured. Medical device development, design and analysis of the biological model, and functional analysis of the cell are lectured.

Advanced Robotics 2 credits
Elective Required
Professor Satoshi Murata
Professor Shuji Tanaka
Professor Yasuhisa Hirata
Professor Mitsuhiro Hayashibe
Professor Yoshiaki Kanamori
Professor Yoichi Haga
Professor Mami Tanaka
Associate Professor Naoki Inomata
Associate Professor Yusuke Tamura
Associate Professor Shin-ichiro Nomura
Associate Professor Takashiro Tsukamoto
Associate Professor Dai Owaki
Associate Professor Takeshi Okuyama

A robot system can be constructed by organically integrating actuators that realize motion, mechanical elements, microprocessors and sensors

Intelligent Mechanosystem Engineering 2 credits
Elective Required
Professor Makoto Ohta
Associate Professor Kenichi Funamoto

To realize intelligent mechano-systems that autonomously adapt to their environment, it is essential to understand the structure and the mechanisms of sensing and decision-making of intelligent systems in living organisms. This lecture focuses on problems related to the fundamentals and applications of optimization of complex dynamic systems, and aims to develop an intuitive understanding of the most common methods of optimization theory by functional analysis.

that are necessary for realizing intelligent motion. In this lecture, we will focus on cultivating the ability to conceptualize, find problems, and solve problems, which are necessary for the integration of robot systems. Intelligent robots, bio-mechatronics, intelligent mechatronics, micro/nano-mechatronics, etc. will be the subject of concrete research, and lectures and discussions will be held.	
Advanced Intelligent Design 2 credits Elective Required Professor Takahito Ono Professor Masayoshi Mizutani Nanotechnology-based nano-precision mechanical manufacturing and micro-nanomachining, and integration technologies of various components are lectured. Precision machines based on above technologies and micro-nanomachines, the design and modeling of those mechanical elements, recent research on applications to information technologies, energy, and medical fields are also lectured.	**Advanced Nano/Technology** 2 credits Elective Required Professor Gao Wei Professor Koshi Adachi This course focuses on two main fields of nanotechnologies. The first field is tribology, which is the technical and scientific aspect of contact surface. Fundamental of tribology and tribological performance of the contact surface will be taught in the class. The second field is nanometrology, which is the science of measurement in the nanometric scale. The fundamental and systems of nanometrology based on optics will be introduced.
Special Lecture on Robotics B 1~4 credits Elective Required A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.	**Special Seminar on Robotics B** 1~4 credits Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.
Doctoral Thesis Research in Robotics 8 credits Required Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.	

授業科目表（DC）List of Courses

Department of Aerospace Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，特別講義 B，特別研修 B，及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること．なお，特別講義 B と特別研修 B 及び関連科目で修得した単位は４単位まで本要件に含めることができる． A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	航空システム特論 Ⅰ Advanced Aero Systems Ⅰ		E		2		
	航空システム特論 Ⅱ Advanced Aero Systems Ⅱ		E		2		
	宇宙システム特論 Ⅰ Advanced Space Systems Ⅰ	毎年 Every year	E		2		
	宇宙システム特論 II Advanced Space Systems II	毎年 Every year	E		2		
	航空宇宙流体工学特論 Advanced Space Fluid Dynamics		E		2		
専門科目 Major General Subjects	航空宇宙工学特別講義Ｂ Special Lecture on Aerospace Engineering B				1～4		
	航空宇宙工学特別研修Ｂ Advanced Seminar on Aerospace Engineering B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	航空宇宙工学博士研修 Doctoral Thesis Research in Aeronautics and Space Engineering			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。（自専攻の学際基盤科目から 4 単位以上履修すること。ただし、特別講義Ｂ、特別研修Ｂ及び他専攻・他研究科の関連科目の内から 4 単位以上を選択履修することもできる）

Students must acquire 16 or more credits from the subjects above. (Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department and can also select 4 or more credits from Special Lecture B, Advanced Seminar B and Related subjects of other departments or other schools.)

2，『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3，「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits Elective Required Professor Shuji Tanaka Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.	**New Business Creation** 2 credits Elective Required Professor Shuichi Ishida This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.
Venture Strategy 2 credits Elective Required	**Nano Magnetism and Magnetic Engineering** 2 credits Elective Required Professor Daichi Chiba Associate Professor Hikaru Nomura Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.
Advanced Aero Systems I 2 credits Elective Required Professor Tomonaga Okabe Professor Soshi Kawai This course covers computational methods used in aerospace engineering problems and includes the following topics: 1. Introduction to the continuum mechanics for the application of structural analysis and computational fluid dynamics 2. Finite element methods for structural analysis and nonlinear problems. 3. Mathematical foundations of modern computational fluid dynamics and the application to aircraft design processes. 4. Mathematical formulation of multidisciplinary design problems and overview of gradient-based and gradient-free algorithms. 5. Dynamic mode decomposition for modelling of complex and interactive problems.	**Advanced Aero Systems II** 2 credits Elective Required Professor Tomonaga Okabe Professor Soshi Kawai This course provides the topics of advanced fluid mechanics research in aerospace engineering and its related fields, such as aircraft aerodynamic design processes, etc., to study the existing advanced knowledge and remaining issues in the areas of fluid mechanics. The topics will broadly include numerical and experimental research in fluid mechanics and how fluid mechanics research applies to aircraft design processes. Students are expected to acquire the ability to problem-finding and set as doctoral course students through the various topics of fluid mechanics research provided.

Advanced Space Systems I 2 credits Elective Required Professor Kazuya Yoshida Professor Naofumi Ohnishi Professor Kanjuro Makihara Associate Professor Toshinori Kuwahara This course covers advanced issues on space flight systems, which are useful for elaborating PhD level studies of space engineering: ・The scope of the course is the design, development, launch and operation of space flight systems for Earth-orbiting missions and/or interplanetary missions. ・Depending on the availability of the lecturers, a specific focus will be made on the topics from propulsion systems, space structures, orbital mechanics, attitude dynamics and control, and space robotics. ・Lectures can be conducted by invited international lectures.	**Advanced Space Systems II** 2 credits Elective Required Professor Kazuya Yoshida Professor Naofumi Ohnishi Professor Kanjuro Makihara Associate Professor Toshinori Kuwahara This course provides extensive advanced lectures on space flight systems, particularly the issues not covered by Advanced Space Systems I: ・The scope of the course is the design, development, launch and operation of space flight systems for Earth-orbiting missions and/or interplanetary missions. ・Depending on the availability of the lecturers, a specific focus will be made on the topics from propulsion systems, space structures, orbital mechanics, attitude dynamics and control, and space robotics. ・Lectures can be conducted by invited international lectures. ・All lectures are given in English.
Advanced Space Fluid Dynamics 2 credits Elective Required Professor Hiroki Nagai Professor Shigeru Obayashi From aerospace engineering and the related fields, this lecture delivers extensive and deep technical knowledge about extreme flows such as the hypersonic flow, propulsion of the spacecraft, flows with various flights. The principal objective of the lecture is the cultivation of the ability of the doctoral course students for problem discovery and the proposition of a new solution method.	**Special Lecture on Aerospace Engineering B** 1~4 credits Elective Required A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.
Special Seminar on Aerospace Engineering B 1~4 credits Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.	**Doctoral Thesis Research in Aeronautics and Space Engineering** 8 credits Required Students engage in experiments and seminars, including research presentations, discussion, and literature reviews.

授業科目表（DC）List of Courses

Department of Quantum Science and Energy Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	近代技術史学 History of Modern Technology	毎年 Every year	J		2		左記の学際基盤科目，工学特別セミナー,特別講義 B, 特別研修 B, 及び関連科目の内から４科目以上を選択履修し，８単位以上を修得すること．なお，工学特別セミナー,特別講義 B と特別研修 B 及び関連科目で修得した単位は４単位まで本要件に含めることができる． A student has to earn 8 or more credits from the Interdisciplinary basic subjects listed in the left column. However, a total of 4 credits at most, obtained from Special seminar on Engineering, Advanced seminar B, Special lecture B, and Related subjects are included in this requirement.
	新事業創造論 New Business Creation	毎年 Every year	J		2		
	ベンチャー企業戦略 Venture Strategy		J		2		
	ナノ磁気工学特論 Nano Magnetism and Magnetic Engineering		JE		2		
	リスク管理学特論 Advanced Theory and Practice of Risk Assessment and Management	毎年 Every year	J		2		
	原子核システム安全工学特論 Advanced Safety Engineering of Nuclear Systems	毎年 Every year	J		2		
	核融合炉工学特論 Advanced Fusion Reactor Engineering		J		2		
	保健物理工学特論 Advanced Health Physics Engineering		JE		2		
	原子力材料ナノ分析学特論 Nanoscale Analysis of Nuclear Materials		J		2		
	アクチノイド物性工学特論 Engineering for Actinide Materials		J		2		
	原子力化学工学特論 Advanced Nuclear Chemical Engineering		J		2		
	エネルギー物理工学特論 Advanced Energy Physics Engineering		JE		2		
	粒子ビーム工学特論 Advanced Particle Beam Engineering		JE		2		
	エネルギー材料工学特論 Advanced Energy Material Engineering		JE		2		
	加速器放射線工学特論 Advanced Accelerator and Radiation Engineering		JE		2		
	量子エネルギー工学特論 Advanced Quantum Science and Energy Engineering		E		2		
専門科目 Major General Subjects	工学特別セミナー Special Seminar on Engineering		J		2		

	量子エネルギー工学特別講義Ｂ Special Lecture on Quantum Energy Engineering B				1～4		
	量子エネルギー工学特別研修Ｂ Special Seminar on Quantum Energy Engineering B				1～4		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	量子エネルギー工学博士研修 Doctoral Thesis Research in Quantum Science and Energy Engineering			8			

1, 上記科目の単位数を合わせて 16 単位以上を修得すること。（自専攻の学際基盤科目から 4 単位以上履修すること。ただし、工学特別セミナー、特別講義Ｂ、特別研修Ｂ及び関連科目の内から 4 単位以上を選択履修することもできる）

Students must acquire 16 or more credits from the subjects above. (Students must acquire 4 or more credits from the Interdisciplinary Basic subjects of their own department and can also select 4 or more credits from Special Seminar on Engineering, Special Lecture B, Special Seminar B, and Related subjects.)

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

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Language Key

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JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

History of Modern Technology 2 credits
Elective Required
Professor Shuji Tanaka

Learning the history of technology leads to understanding the origin and genealogy of the technology, the inevitable factors of technological development, the relationship between society and the technology, the process and consequence of try-and-errors, the successes and failures of engineers and researchers etc. This intensive class introduces the development and partially decline of familiar devices and technologies such as automobile engines, memory devices, communication tools and semiconductor integrated circuits. The history of each technology includes the philosophy and lessons which are also useful for other research and development, and thus attendee is expected to consider them for their doctoral theses and future research and development. The lectures are partially given by visiting lecturers, and fully given in Japanese.

New Business Creation 2 credits
Elective Required
Professor Shuichi Ishida

This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

Venture Strategy 2 credits
Elective Required

Nano Magnetism and Magnetic Engineering 2 credits
Elective Required
Professor Daichi Chiba
Associate Professor Hikaru Nomura

Magnetic materials are essential to human life, such as motors and electrical generators. As magnetic materials become nanoscale, their functionality expands and they are widely used in applications such as magnetic recording and magnetic field sensing. In recent years, magneto-elastic effects in nanomagnets have been found efficient for sensitive sensing of mechanical motions, and the connection between nanomagnets and mechanics is attracting attention. In this lecture, students will learn the fundamental properties of magnetic materials and their characteristics, and gain a broad knowledge of physical phenomena and applications in spintronics, a field of study in which nanomagnets are used for research and development. This lecture will be given in a face-to-face style with some exercises.

Advanced Theory and Practice of Risk Assessment and Management 2 credits
Elective Required
Professor Makoto Takahashi
Associate Professor Daisuke Karikawa

The aim of this lecture is to understand practical methodology of risk assessment and management for large-scale complex socio-technical systems. The activities of traditional safety risk management are mainly reactive, meaning they focus on correcting defects after negative events occurred. This lecture, on the other hand, discusses proactive risk management methodology with emphasis on human-machine interaction, organizational issues, and the concepts of resilience engineering. The topics of this lecture also cover risk communication and engineering ethics.

Advanced Safety Engineering of Nuclear Systems 2 credits
Elective Required
Professor Yutaka Watanabe
Professor Yuichi Niibori
Professor Makoto Takahashi
Professor Noritake Yusa
A specially appointed professor Koji Dozaki
Visiting Professor Masahiro Yamamoto

Regarding aging management technology of light water reactors, the following important themes on the safety of nuclear systems are discussed from a wide viewpoint, including reconstruction of nuclear safety logic, management of obsolete designs, human factors, active faults, mid-and long-term measures for the restoration of the Fukushima Daiichi Nuclear Power Station, and treatment and disposal of radioactive waste. The lectures cover the latest situation of technical background and academic foundation, as well.

Advanced Fusion Reactor Engineering 2 credits
Elective Required
Professor Hidetoshi Hashizume
Associate Professor Shinji Ebara
Associate Professor Satoshi Ito
Visiting Professor Nagato Yanagi
Visiting Professor Takuya Nagasaka

In this lecture, the magnetic confinement fusion reactor is discussed as a fusion power generation system, and the overall design and performance requirements of the components are outlined. In order to deepen the understanding of superconducting magnets, blankets and divertors, which are components with many engineering challenges, the lecture will cover the basic physics behind them and their applications, as well as an understanding of the complex thermal, electromagnetic fluid, and structural problems and solutions for the design of each component. In addition, the course will explain the basic items necessary for material selection and the current status of material development in order to cultivate a deep understanding of materials for fusion reactor components, which are being developed with long-term integrity under extreme conditions and with consideration for economic efficiency and future waste issues.

Advanced Health Physics Engineering 2 credits
Elective Required
Professor Hiroshi Watabe
Associate Professor Miho Shidahara

Health physics engineering is the field of research on safe exposure levels, shielding, and treatment of radioactive waste to prevent radiation hazards. In recent years, various accelerator usages have spread, and the importance of health physics engineering has increased.
When utilizing radiation emitted from accelerators and radioisotopes generated by accelerators for medical purposes such as diagnosis and treatment, it is important to take appropriate safety measures in consideration of the effects on the human body.
In this special lecture, we will learn several aspects of radiation utilization and protection including regulation rules and laws, effects on humans, radiation dose assessment, shielding and protection, etc. Monte Carlo simulation will be practically learned.

Nanoscale Analysis of Nuclear Materials 2 credits
Elective Required
Professor Yasuyoshi Nagai
Associate Professor Koji Inoue
Associate Professor Takeshi Toyama
Associate Professor Kenta Yoshida

In order to understand and control the mechanical property changes of the various nuclear materials by irradiations, it is important to obtain the nanoscale structural and chemical information.
In this special lecture, we will learn several state-of-the-art nanoscale analysis methods, including transmission electron microscopy, three-dimensional atom probe, and positron annihilation spectroscopy.

Engineering for Actinide Materials 2 credits
Elective Required
Professor Dai Aoki
Associate Professor Seong-Yun Kim

This course includes the lectures on the characteristics of actinoid elements by paying attention to differences between them and rare earth elements and transition elements. Physical and chemical properties of substances containing actinoid elements will be explained with the latest topics. In particular, the emphasis is on non-conventional exotic superconducting phenomena observed in actinoid compounds, experimental technology under extreme environment, and single crystal growth technology. The lectures will also cover nuclear fuel reprocessing and radioactive waste disposal. The goal of the course is to gain knowledge from a wide range of physical, chemical, and engineering perspectives related to actinoid elements.

Advanced Nuclear Chemical Engineering 2 credits
Elective Required
Professor Akira Kirishima
Associate Professor Seong-Yun Kim
Visiting Professor Masayuki Watanabe
Lecturer Daisuke Akiyama

Chemistry plays an important role in nuclear engineering, especially in the fabrication of nuclear fuels, reprocessing of spent nuclear fuels, and radioactive waste management. Also, there are many chemical engineering tasks in the field of decommissioning the severely damaged reactors by the Fukushima NPP accident in 2011 and recovery from the contaminated environment. To respond to these demands, chemistry aspects in nuclear engineering and related basic chemistry concerning actinide elements are lectured in this class. It is recommended to have studied the undergraduate class "Radiochemistry" as a base of this lecture.

Advanced Energy Physics Engineering 2 credits
Elective Required
Professor Hidetoshi Hashizume
Professor Kenji Tobita
Associate Professor Shinji Ebara
Associate Professor Satoshi Ito
Associate Professor Tetsutaro Oishi

This class provides advanced technology and its basic knowledge in terms of energy system and neutronics of fusion and fission reactors. Several forefront topics are introduced on the advanced reactor engineering, energy flow dynamics, neutron utilization and fusion plasma confinement to learn how to pick up crucial issues and then how to solve the problems.

Advanced Particle Beam Engineering 2 credits Elective Required Professor Shigeo Matsuyama Professor Shozo Furumoto Professor Manabu Tashiro Professor Atsuki Terakawa Associate Professor Yohei Kikuchi Associate Professor Keitaro Hitomi Associate Professor Seong-Yun Kim Associate Professor Miho Shidahara Associate Professor Wataru Kada This class provides basic concepts of interaction between energetic particles and materials based on physics of atomic displacement and nuclear transmutation behavior of energetic particles and atoms of the materials in nuclear power systems. Material development for the nuclear systems and their characteristics from the viewpoint of materials science and engineering are explained.	**Advanced Energy Material Engineering** 2 credits Elective Required Professor Eiji Akiyama Professor Ryuta Kasada This lecture will provide the following topics: 1. Environmental effects of advanced energy materials and their fundamentals. 2. Irradiation effects of advanced energy materials and their fundamentals. 3. Advanced analyses and measurements of energy materials.
Advanced Accelerator and Radiation Engineering 2 credits Elective Required Professor Hiroshi Watabe Associate Professor Keitaro Hitomi In order to develop effective utilization of accelerator radiation for engineering and medical purposes, specialized knowledge of radiation engineering based on radiation physics will be lectured, and advanced topics will be discussed in order to cultivate the ability to identify and solve problems related to accelerator and medical physics. Biological effects of radiation and protection methods for various accelerator facilities will be discussed in detail to ensure the safety of accelerator radiation, which is a prerequisite for the use of accelerators.	**Advanced Quantum Science and Energy Engineering** 2 credits Elective Required Professors of Department This lecture will deal with the following topics. 1. The engineering and physics foundation, and innovative technologies of nuclear energy systems, safety systems, and recycling systems. 2. The engineering and physics foundation of advanced nuclear reactors, such as nuclear fusion and ADS. 3. The science and innovative technology for high loading energy. 4. Applied particle-beam technology.
Special Seminar on Engineering 2 credits Elective Required The purpose of the special seminar is to to acquire practical knowledge in the fields of quantum science and engineering by participating in the "Interdisciplinary Seminar" held in the Department or by attending a seminar on the engineering field in the University.	**Special Lecture on Quantum Energy Engineering B** 1~4 credits Elective Required A special lecture on leading-edge academic research in the major area, or on the creation and development of knowledge in relation to the major area.
Special Seminar on Quantum Energy Engineering B 1~4 credits Elective Required The problem-posing ability is acquired by integrating advanced expertise through the training.	**Doctoral Thesis Research in Quantum Science and Energy Engineering** 8 credits Required Students fulfill doctoral thesis research through experiments, numerical simulations, analysis, research presentations, discussions, literature reviews in any research group specializing in advanced nuclear engineering, nuclear system safety engineering, energy physics, particle beam engineering, energy material engineering, energy chemical engineering, quantum physics engineering, or accelerator and radiological engineering.

授業科目表（DC）Opening of a course class subject list

Department of Electrical Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	Advanced Energy Device Engineering	※	JE		2		A Student has to earn 6 or more credits from the interdisciplinary basic subjects listed in the left column or the related subjects (2 or more credits from the interdisciplinary basic subjects.)
	Advanced Electrical Energy System Engineering	※	JE		2		
	Advanced Intelligent Energy System Engineering	※	JE		2		
	Advanced Bioelectromagnetics	※	E		2		
	Advanced Spintronics Materials and Engineering	Every year	JE		2		
	Intellectual Property Strategy	Every Year	J		1		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Special Lecture on Electrical Engineering B				1~2		
	Writing and Presentation for English Technical Paper B	Every year	E		2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Advanced Seminar on Electrical Engineering			2			
	Doctoral Thesis Research in Electrical Engineering			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。

Students must acquire 16 or more credits from the subjects above.

2，『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

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Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

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E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Advanced Energy Device Engineering 2 credits Elective Required Professor Endoh T, Professor Endo Y, Professor Ishiyama, Professor Yabukami, Professor Nakamura, Visiting Professor Yashima, Associate Professor Kuwahata, Lecturer Aoki Energy devices in electrical engineering and related fields, along with lectures on broad and deep expertise in applications. In addition, it is necessary to discover current problems and develop new solutions. Investigate problem-solving methods, focus on cultivate ability to find problems, generation of fusion energy and power conversion are subjects of concrete investigation.	**Advanced Electrical Energy System Engineering** 2 credits Elective Required Professor Saito, Professor Tsuda, Visiting Professor Yashima, Professor Ishiguro, Professor Sugita, Associate Professor Takahashi, Associate Professor Nagasaki, Associate Professor Kano Lectures on extensive and deep expertise in technologies related to electrical energy systems and related fields are provided, as well as to improve the ability of doctoral students to find and set problems by presenting problems at the present time, discovering problems, and investigating solutions to them. Specific studies will be conducted on the monitoring, control, operation, and planning of electric power systems, the conversion and control of electric power by power electronics, the transportation and storage of electrical energy by superconductivity, and the energy application of high-density plasma.
Advanced Intelligent Energy System Engineering 2 credits Elective Required Professor Ishiyama, Professor Ishiguro, Professor Sugita Students will be taught information energy systems among electrical engineering and related fields. In the lectures students acquire broad and deep expertise. In addition, students will develop the ability to investigate current problems and develop new solutions to address them as doctoral course students.	**Advanced Bioelectromagnetics** 2 credits Elective Required This lecture will deal with various aspects of bioelectromagnetics from basic knowledge to advanced subjects. Focus will be placed on overview of the health effects problem and on topics of biological effects and medical applications of electromagnetic fields and waves. Safety standards will be discussed.
Advanced Spintronics Materials and Engineering 2 credits Elective Required Professor Endo, Professor Saito, Professor Ishiyama, Professor Shirai, Professor Fukami, Professor Okamoto, Professor Mizukami, Professor Oogane, Associate Professor Ogawa, Associate Professor Otsuka, Associate Professor Kanai, Associate Professor Greaves, Associate Professor Naganuma Spintronics is an important core research field which supports related technologies such as next-generation electronics, data storage systems, bio-medical applications, and motors. The aim of this class is to acquire broad and deep expert knowledge of spintronics including magnetic materials, various device applications and new paradigms of electronics.	**Intellectual Property Strategy** 1 credits Elective Required Professor Ishida Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.
Domestic Internship Training 1~2 credits Elective Required All Faculty During the two weeks to three months of the doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.	**International Internship Training** 1~2 credits Elective Required All Faculty During the two weeks to three months of the doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. outside Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand R & D planning, research, product development, manufacturing, quality control, group collaborative work, etc. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

Special Lecture on Electrical Engineering B 1~2 credits Elective Required The lecture is a special lecture on the latest academic research in a specialized field or on the creation and development of academic studies related to a specialized field.	**Writing and Presentation for English Technical Paper B** 2 credits Elective Required This course teaches reading and writing techniques for theoretical texts in science and engineering, as well as the English grammar that forms the basis for these techniques, in order to acquire the skills needed to write papers in English for the international dissemination of research results
Advanced Seminar on Electrical Engineering 2 credits Required All Faculty This is a seminar education by multiple teachers from different fields, and students acquire the ability to set problems by combining highly specialized knowledge.	**Doctoral Thesis Research in Electrical Engineering** 8 credits Required All Faculty Students will be assigned to groups in Energy Device Engineering, Electrical Energy System Engineering, Intelligent Energy System Engineering, and participate in experiments and exercises including research presentations, discussions, and etc.

授業科目表（DC）Opening of a course class subject list

Department of Communications Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	選択必須 Elective Required	選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	Advanced Communication Network Engineering		JE		2		A Student has to earn 6 or more credits from the interdisciplinary basic subjects listed in the left column or the related subjects (2 or more credits from the interdisciplinary basic subjects.)
	Advanced Wave Engineering		JE		2		
	Advanced Wave Transmission Engineering		JE		2		
	Advanced High-Speed Communication Engineering		E		2		
	Advanced Spintronics Materials and Engineering	Every year	JE		2		
	Intellectual Property Strategy	Every Year	J		1		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Special Lecture on Communications Engineering B				1~2		
	Writing and Presentation for English Technical Paper B	Every year	E		2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Advanced Seminar on Communication Engineering			2			
	Doctoral Thesis Research in Communication Engineering			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。

Students must acquire 16 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

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Advanced Communication Network Engineering 2 credits
Elective Required
Professor Ito, Professor Omachi,
Professor Nishiyama

This course provides students with wide-ranging and in-depth specialized knowledge of communication engineering and, of all related fields, communication networks. It also examines current problems and corresponding new problem-solving methods, with a focus on cultivating the problem-finding and problem-setting abilities of doctoral students. The subjects of this course are the construction of communication networks and systems that integrate information systems and communication networks.

Advanced Wave Engineering 2 credits
Elective Required
Professor Chen, Professor Matsuura, Professor Yoshizawa

This lecture presents the fundamentals and applications of light waves, radio waves, and sound waves in communications engineering and related fields, with a wide scope and deep range in the fields of wave engineering. The cutting-edge researches on the wave phenomena are also introduced.

Advanced Wave Transmission Engineering 2 credits
Elective Required
Professor Hanyu, Professor Otsuji,
Professor Hirooka, Professor Suematsu, Professor Homma

The series of lectures provide broad and deep expertise about generation and propagation of light waves and electromagnetic waves in electrical communication engineering and the related fields. Students will discover current issues and study new problem-solving methods to deal with them. Lectures mainly focus on cultivating abilities of problem-finding and problem-setting for doctoral course students.

Advanced High-Speed Communication Engineering 2 credits
Elective Required
Professor Otsuji, Professor Yasaka,
Professor Suematsu

This series of lectures provide with various topics in the field of high-speed and high frequency communication engineering. Each lecture consists of a review and discussion in the areas of microwave, infrared, submillimeter wave, terahertz, acoustoelectronic, and quantum electronic engineering.

Advanced Spintronics Materials and Engineering 2 credits
Elective Required
Professor Endo, Professor Saito, Professor Ishiyama, Professor Shirai,
Professor Fukami, Professor Okamoto, Professor Mizukami,
Professor Oogane, Associate Professor Ogawa,
Associate Professor Otsuka, Associate Professor Kanai,
Associate Professor Greaves, Associate Professor Naganuma

Spintronics is an important core research field which supports related technologies such as next-generation electronics, data storage systems, bio-medical applications, and motors. The aim of this class is to acquire broad and deep expert knowledge of spintronics including magnetic materials, various device applications and new paradigms of electronics.

Intellectual Property Strategy 1 credits
Elective Required
Professor Ishida

Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.

Domestic Internship Training 1~2 credits
Elective Required
All Faculty

During the two weeks to three months of the doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

International Internship Training 1~2 credits
Elective Required
All Faculty

During the two weeks to three months of the doctor’s program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. outside Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand R & D planning, research, product development, manufacturing, quality control, group collaborative work, etc. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.

Special Lecture on Communication Engineering B 1~2 credits Elective Required The lecture is a special lecture on the latest academic research in a specialized field or on the creation and development of academic studies related to a specialized field.	**Writing and Presentation for English Technical Paper B** 2 credits Elective Required To explain the basic structure of an academic essay, line by line, so students can construct an effective and convincing essay entirely in English. The class will cover the introduction paragraph, the body paragraph, and the conclusion paragraph, as well as the processes involved in developing effective titles, appropriate citation formatting, and basic grammar tips to help students draft the best academic essay that they are capable of.
Advanced Seminar on Communication Engineering 2 credits Required All Faculty This is a seminar education by multiple teachers from different fields, and students acquire the ability to set problems by combining highly specialized knowledge.	**Doctoral Thesis Research in Communication Engineering** 8 credits Required All Faculty Students will be assigned to groups in Intelligent Communication Network Engineering, Communication System Engineering, Wave Engineering, Wave Transmission Engineering, and participate in experiments and exercises including research presentations, discussions, and etc.

授業科目表（DC）Opening of a course class subject list

Department of Electronic Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	Advanced Nanoelectronic Engineering		JE		2		A Student has to earn 6 or more credits from the interdisciplinary basic subjects listed in the left column or the related subjects (2 or more credits from the interdisciplinary basic subjects.)
	Advanced Electronic Control Engineering		J		2		
	Advanced Material Science and Engineering		JE		2		
	Advanced Electronic System Engineering		JE		2		
	Advanced Electronic Device Engineering		E		2		
	Advanced Electronic Material Engineering		JE		2		
	Advanced Electronic Material Science and System Engineering		E		2		
	Advanced Topics on Microscopic Processing		J		2		
	Advanced High-Speed Communication Engineering		E		2		
	Advanced Spintronics Materials and Engineering	Every year	JE		2		
	Intellectual Property Strategy	Every Year	J		1		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Special Lecture on Electronic Engineering B				1~2		
	Writing and Presentation for English Technical Paper B	Every year	E		2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Advanced Seminar on Electronic Engineering			2			
	Doctoral Thesis Research in Electronic Engineering			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。

Students must acquire 16 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Class Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Advanced Nanoelectronics Engineering 2 credits
Elective Required
Professor Saito

This class provides in-depth lectures on specialized knowledge on academic understanding and engineering applications in the field of nano-electronics, which has recently been remarkably progressing. And focuses on cultivating the problem-finding and problem-solving abilities of doctoral students and improving their insight through the discovery of currently unexplored problems and the investigation of new methods to solve them.

Advanced Electronic Control Engineering 2 credits
Elective Required

A wide range and deep expertise in electronic control engineering among electronic engineering and related fields. In addition, we focus on cultivating the ability of doctoral course students to find and set up problems by discovering current problems and investigating new problem-solving methods to deal with them.

Advanced Material Science and Engineering 2 credits
Elective Required
Professor Kaneko

This course provides a broad and deep expertise in the field of electronic engineering and related fields, especially in the field of material science and engineering. In this course, the main emphasis is placed on the cultivation of problem-finding and problem-solving abilities of doctoral students by identifying current problems and developing new problem-solving methods to address them. Plasma science and engineering, semiconductor science and engineering, and electronic physics are the specific subjects of study.

Advanced Electronic System Engineering 2 credits
Elective Required
Professor Yoshinobu, Professor Fujikake, Professor Watanabe, Professor Higurashi

This course focuses on system engineering within the fields of electronics and related areas. Students will learn broad and profound knowledge and expertise as well as improve their abilities to detect and solve problems. Specifically, measurement and control systems, display systems, medical devices, and MEMS will be considered.

Advanced Electronic Device Engineering 2 credits
Elective Required
Professor Yasaka, Professor Otsuji, Professor Sato, Professor Fukami

Based on recent research results, lectures will be given on deep specialized knowledge and future prospects in the fields of electronic engineering and related fields such as physical engineering, ultrafine electronic engineering, electronic system engineering, and electronic control engineering. In addition, the focus is on cultivating the ability of doctoral course students to identify and set up problems by discovering current problems and investigating new problem-solving methods to deal with them.

Advanced Electronic Material Engineering 2 credits
Elective Required
Professor Shirai

Students will learn broad and deep expert knowledge of electronic materials and their applications to electronic engineering and related fields. Students will study the methods to find current problems and to solve them. The aim of this class is to acquire the ability of problem finding/setting required for doctoral course students. The subject of study includes photo-electronic, semiconducting, and magnetic materials, and so on.

Advanced Electronic Material Science and System Engineering 2 credits
Elective Required
Professor Saito, Professor Kaneko,
Professor Kitamura, Professor Fujikake, Professor Higudashi,
Professor Yoshinobu,

Students will be taught the advanced topics on microscopic processing for manufacturing LSI, magnetic memories and displays. This course covers a thorough and deep knowledge on the topics as well as, the current issues and their possible solutions. Through the classes this course is targeted to provide doctoral students with the abilities toward finding and solving problems. Classes will focus on the ultra-clean and high-density process technologies, nanoscale material design and measurements of solid-state surfaces, especially fabrications and measurements of highly scaled-down and three-dimensional structures.

Advanced Topics on Microscopic Processing 2 credits
Elective Required
Professor Kuroda, Professor Higurashi

Students will be taught the advanced topics on microscopic processing for manufacturing LSI, magnetic memories and displays. This course covers a thorough and deep knowledge on the topics as well as, the current issues and their possible solutions. Through the classes this course is targeted to provide doctoral students with the abilities toward finding and solving problems. Classes will focus on the ultra-clean and high-density process technologies, nanoscale material design and measurements of solid-state surfaces, especially fabrications and measurements of highly scaled-down and three-dimensional structures.

Advanced High-Speed Communication Engineering 2 credits Elective Required Professor Otsuji, Professor Yasaka, Professor Yamada, Professor Suematsu This series of lectures provide with various topics in the field of high-speed and high frequency communication engineering. Each lecture consists of a review and discussion in the areas of microwave, infrared, submillimeter wave, terahertz, acoustoelectronic, and quantum electronic engineering.	**Advanced Spintronics Materials and Engineering** 2 credits Elective Required Professor Endo, Professor Saito, Professor Ishiyama, Professor Shirai, Professor Fukami, Professor Okamoto, Professor Mizukami, Professor Oogane, Associate Professor Ogawa, Associate Professor Otsuka, Associate Professor Kanai, Associate Professor Greaves, Associate Professor Naganuma Spintronics is an important core research field which supports related technologies such as next-generation electronics, data storage systems, bio-medical applications, and motors. The aim of this class is to acquire broad and deep expert knowledge of spintronics including magnetic materials, various device applications and new paradigms of electronics.
Intellectual Property Strategy 1 credits Elective Required Professor Ishida Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.	**Domestic Internship Training** 1~2 credits Elective Required All Faculty During the two weeks to three months of the doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. in Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand product planning, market research, product development, manufacturing, quality control, group collaborative work, etc. in companies. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.
International Internship Training 1~2 credits Elective Required All Faculty During the two weeks to three months of the doctor's program, R & D activities will be conducted at research institutes, R & D departments, factories, etc. outside Japan as on-the-job training. Through this training, you will learn how to practice daily university research in the field of research and development, and experience and understand R & D planning, research, product development, manufacturing, quality control, group collaborative work, etc. The trainee submits a report to the training place and the academic advisor, and if the academic advisor recognizes that the research and development activities have been carried out, credits will be granted. 1 credit for training for 37.5 hours or more and less than 75 hours, and 2 credits for training for 75 hours or more.	**Special Lecture on Electronic Engineering B** 1~2 credits Elective Required The lecture is a special lecture on the latest academic research in a specialized field or on the creation and development of academic studies related to a specialized field.
Writing and Presentation for English Technical Paper B 2 credits Elective Required To explain the basic structure of an academic essay, line by line, so students can construct an effective and convincing essay entirely in English. The class will cover the introduction paragraph, the body paragraph, and the conclusion paragraph, as well as the processes involved in developing effective titles, appropriate citation formatting, and basic grammar tips to help students draft the best academic essay that they are capable of	**Advanced Seminar on Electronic Engineering** 2 credits Elective Required All Faculty This is a seminar education by multiple teachers from different fields, and students acquire the ability to set problems by combining highly specialized knowledge.

Doctoral Thesis Research in Electronic Engineering 8 credits

Elective Required

All Faculty

Students will be assigned to groups in Spin Nano-Electronic Engineering, Electronic Control Engineering, Material Science and Engineering, Electronic System, and participate in experiments and exercises including research presentations, discussions, and etc.

授業科目表（DC）Opening of a course class subject list

Department of Applied Physics

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit			備考 Remarks
				必須 Required	選択必須 Elective Required	選択 Elective	
学際基盤科目 Interdisciplinary Basic Subjects	Advanced Course in Applied Interface Physics	※	J		2		A Student has to earn 6 or more credits from the interdisciplinary basic subjects listed in the left column or the related subjects (2 or more credits from the interdisciplinary basic subjects.)
	Advanced Course in Applied Solid State Physics	※	J		2		
	Advanced Course in Applied Material Physics	※	J		2		
	Advanced Course in Low Temperature Electronic Materials	※	J		2		
	Advanced Course in Electron and Photon Measurements	※	J		2		
	Advanced Course in Applied Physical Engineering	※	J		2		
	Applied Course in Biological Physics	※	J		2		
	Advanced Course in Applied Material Science	※	J		2		
	Quantum Material Physics	※			2		
	Domestic Internship Training				1~2		
	International Internship Training				1~2		
	Special Lecture on Applied Physics B				1~6		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Seminar on Interface Physics				2		A Student has to earn 2 credits from one of the subjects listed in the left column.
	Seminar on Condensed Matter Physics				2		
	Seminar on Material Physics				2		
	Seminar on Physical Measurements				2		
	Doctoral Thesis Research in Applied Physics			8			

1, 上記科目の単位数を合わせて 16 単位以上を修得すること。

Students must acquire 16 or more credits from the subjects above.

2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。

“Class Schedule” is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3,「使用言語」欄のアルファベット記号について

Language Key

E:英語開講科目（Lectures given in English）

JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）

J:日本語開講科目（Lectures given in Japanese）

Advanced Course in Applied Interface Physics 2 credits Elective Required The atomic structure and electronic state of the interface between magnetic, nonmagnetic, ceramic, and organic materials will be lectured. Then, the electromagnetic and mechanical properties of these materials and their evaluation methods and the current status will be explained.	**Advanced Course in Applied Solid State Physics** 2 credits Elective Required Experimental and theoretical studies on the structure and properties of glasses and crystals, especially the control and application of optical properties using nonlinear optical effects will be lectured. The state-of-the-art in the development of related photonic materials will also be discussed in detail.
Advanced Course in Applied Material Physics 2 credits Elective Required The origin of physical properties, crystalline treasures of materials, and their device applications are discussed for semiconductor materials from narrow-gap to wide-gap. Optical devices and switching devices are discussed, and their system applications are also mentioned.	**Advanced Course in Low Temperature Electronic Materials** 2 credits Elective Required Superconducting and spin-electronic materials are based on the quantum effects of charge and spin in solids. In this lecture, the physics of charge and spin in strongly correlated electron systems will be reviewed and the current status of understanding high-temperature superconductivity will be introduced. The development of superconducting magnets and the state-of-the-art of scientific research using high magnetic fields will also be introduced. In addition, the mechanism that spin plays on the stage of electronics will be discussed from a theoretical standpoint.
Advanced Course in Electron and Photon Measurements 2 credits Elective Required Various spectroscopic techniques are required to evaluate the electronic states and functionalities of semiconductors, metals, magnetic materials, and polymers. The state-of-the-art of spectroscopy for superlattices, multilayers, low-dimensional complexes, and organic materials using laser light, X-rays, synchrotron radiation, electron beams, etc. will be discussed in detail.	**Advanced Course in Applied Physical Engineering** 2 credits Elective Required The course provides advanced specialized education in materials science and engineering based on the physical properties of various materials and their origins, materials science and engineering related to magnetic materials with new functions, superconductive materials, optical materials, etc., and physical measurement engineering for the development of precision measurements of physical quantities.
Advanced Course in Biological Physics 2 credits Elective Required Although there are many unexplained aspects of biological mechanisms, it is a fact that more and more things can be understood from the viewpoints of physics and chemistry, and knowledge is being accumulated day by day that gives rise to the possibility of new applications. This course discusses the current status of research to understand biological phenomena from a physical point of view and the development of related technologies.	**Advanced Course in Applied Material Science** 2 credits Elective Required After lectures on vacuum, electric discharge, and film formation processes related to thin film fabrication technology, magnetic thin films are discussed, including magnetic properties, surface properties, and applied properties.
Quantum Material Physics 2 credits Elective Required This course is composed of four topics: Spinelectronics; Ceramics conductors; Fabrication and magneto-optical study of magnetic semiconductor nanostructures; Materials science and device applications of wide-gap semiconductors.	**Domestic Internship Training** 1~2 credits Elective Required The trainees will receive one-week to one-month on-the-job training in practical training and research activities at a company in Japan. Through this training, trainees will gain hands-on experience and understanding of planning, research, product development, manufacturing, quality control, and group work at companies, etc. Trainees will submit a training report to the training site and their supervisor. The trainee submits a training report to the training site and the supervisor. 1 credit is given for training of 40 hours or more, and 2 credits for training of 80 hours or more.

International Internship Training 1~2 credits
Elective Required
All Faculty

The trainees will receive one-week to one-month on-the-job training in practical training and research activities at a company outside of Japan. Through this training, trainees will gain hands-on experience and understanding of planning, research, product development, manufacturing, quality control, and group work at companies, etc. Trainees will submit a training report to the training site and their supervisor. The trainee submits a training report to the training site and the supervisor. 1 credit is given for training of 40 hours or more, and 2 credits for training of 80 hours or more.

Special Lecture on Applied Physics B 1~6 credits
Elective Required

The program aims to promote professional knowledge of doctoral training by introducing the latest specialized and advanced research results by the faculty members in charge and lecturers from outside the university.

Seminar on Interface Physics 2 credits
Elective Required
Professor Mizukami, Professor Oogane

Seminar on the physical mechanism and modeling about spintronic phenomena due to the existence of multilayer interfaces. In addition, seminar on the interfacial design to bring novel functionality from an experimental viewpoint.

Seminar on Condensed Matter Physics 2 credits
Elective Required
Professor Fujiwara, Professor Matsueda, Professor Ono,
Associate Professor Shimizu, Associate Professor Tsuchiura,

Students will be assigned to a seminar for each area of specialization, where they will present their doctor's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Seminar on Material Physics 2 credits
Elective Required
Professor Miyazaki, Professor Awaji, Professor Toyabe,
Professor Yamashita, Associate Professor Kato,
Associate Professor Hayashi, Associate Professor Kimura,
Associate Professor Nakamura, Associate Professor Tsuchiya

Students will be assigned to a seminar for each area of specialization, where they will present their doctor's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Seminar on Physical Measurements 2 credits
Elective Required
Professor Takahashi, Professor Chichibu,
Professor Takada, Professor Okamoto,
Associate Professor Ejima, Associate Professor Watanabe,
Associate Professor Yamamoto, Associate Professor Kikuchi

Students will be assigned to a seminar for each area of specialization, where they will present their doctor's thesis research, engage in discussions based on their research, and exercises that review seminal or recent domestic and international research on the topic.

Doctoral Thesis Research in Applied Physics 8 credits
Required
All Faculty

The doctoral dissertation consists of a literature survey, discussions, exercises, experiments, research presentations, and other activities related to the research topic to be conducted in the process of preparing the doctoral dissertation, the details will be determined by the supervising professor.

(DC) Opening of a course class subject list

Department of Applied Chemistry

Category	Subject	Schedule	Language	Credit			Remarks
				Required	Elective Required	Elective	
Interdisciplinary Basic Subjects	Nano-Interfacial Chemistry	Every year	JE		2		Students must get at least 6 credits from the Interdisciplinary Basic Subjects and Related Subjects of Other Majors listed on the left side(2 credits or more from the subjects listed in Interdisciplinary Basic Subjects).
	Advanced Course in Atoms and Molecules Control Engineering	Every year	JE		2		
	Advanced Resources and Environment	Every year	JE		2		
	Advanced Chemistry of Molecular Systems	Every year	JE		2		
	Advanced Study of Control of Materials Function	Every year	JE		2		
	Doctor Course Special Lectures	Every year	E		2		
Related Subjects of Other Majors	Those approved by the Educational Committee of the Graduate School of Engineering						
Major General Subjects	Advanced Seminar on Atomic and Molecular Control Engineering	Every year	JE		2		Students must get 2 credits from the Major General Subjects listed on the left side.
	Advanced Seminar on Resources and Environment	Every year	JE		2		
	Advanced Seminar on Chemistry of Molecular Systems	Every year	JE		2		
	Advanced Seminar on Control Materials Function	Every year	JE		2		
	Presentation and discussion in English on Applied Chemistry, Chemical Engineering, and Biomolecular Engineering	Every year	E		2		
	Doctoral Thesis Research in Applied Chemistry	Every year		8			

1, At least 16 credits must be obtained from the subjects listed in the Interdisciplinary Basic, Major General, and Related Subjects of Other Majors (12 credits or more from the subjects listed in Interdisciplinary Basic and Major General Subjects).

2, "Class Schedule" is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3, Language Key

E: (Lectures given in English)

JE: (Lectures understandable for Japanese and foreign students)

J: (Lectures given in Japanese)

Nano-Interfacial Chemistry【TACMAC701】

2 credits　Elective Required
Professor Yuji Matsumoto
Associate Professor Shingo Maruyama

Understanding of Nano-Interfacial Chemistry is getting more and more important for modern science & technology in the 21th century. In this class, atomic and molecular-level knowledge that has been rapidly advanced in Interfacial Chemistry today will be provided, based on its phenomenological understanding thus far.

Advanced Course in Atoms and Molecules Control Engineering【TACOEN701】

2 credits　Elective Required
Prof. Yuji Matsumoto
Prof. Keiichi Tomishige　Prof. Masaya Mitsuishi
Prof. Hirotsugu Takizawa　Prof. Keisuke Asai
Prof. Shuichi Oi　Prof. Tomoyuki Akutagawa
Prof. Masaru Nakagawa　Prof. Hiroshi Jinnai
Prof. Hideki Kato　Assoc. Prof. Shingo Maruyama
Assoc. Prof. Yoshinao Nakagawa　Assoc. Prof. Yamato Hayashi
Assoc. Prof. Yutaka Fujimoto　Assoc. Prof.Tomoya Oshikiri
Senior Assistant Prof. Shinya Tanaka
Senior Assistant Prof. Tomohiro Miyata

The ultimate in chemical technology is to control chemical reactions in a broad sense, or reaction fields at the atomic and molecular levels. Here, lectures will be given on various processes for structure and reaction control.

Advanced Resources and Environment【TACOEN702】

2 credits　Elective Required
Professor Keiichi Tomishige
Professor Masaya Mitsuishi
Associate Professor Yoshinao Nakagawa

Deep insights in broad fields of organic resource chemistry and environmental chemistry will be delivered in this subject to help students to find and solve problems in their doctoral works. Topics include the valorization of wastes for chemical recycle of materials and refinery of fossil resources and biomass.

Advanced Chemistry of Molecular Systems【TACOCH701】

2 credits　Elective Required
Professor Hirotsugu Takizawa
Professor Keisuke Asai
Associate Professor Yamato Hayashi
Associate Professor Yutaka Fujimoto

The functionality of solid materials is deeply discussed from the viewpoint of “structure-property relationship” based on crystal chemistry and higher-order structures. Emphasis is focused on cultivating problem-finding abilities as a doctoral course student.

Advanced Study of Control of Materials Function【TACOCH702】

2 credits　Elective Required
Prof. Shuichi Oi　Prof. Tomoyuki Akutagawa
Prof. Masaru Nakagawa　Prof. Hiroshi Jinnai
Prof. Hideki Kato　Assoc. Prof.Tomoya Oshikiri
Senior Assistant Prof. Shinya Tanaka
Senior Assistant Prof. Tomohiro Miyata

Control methods of functions based on interfacial states, molecular arrangements, and material composition in materials chemistry will be lectured. Subjects include interfacial reactions, built-up films, and improve methods of material functions using optical attributes.

Doctor Course Special Lectures【TACOEN710】

2 credits　Elective Required
Professor Masaya Mitsuishi
Professor Hideyuki Aoki
Professor Hitoshi Shiku
Associate Professor Fabio Pichierri

A chemistry-related theme will be discussed in each lesson. Students will search information (from papers, books, the Internet, etc.) related to the weekly theme and they will introduce it to the class. Students will use the blackboard to summarize the information delivered to the class and they will make simple drawings of the concepts behind the scientific topic under discussion. All the students in the class will offer comments and questions to the speaker. The discussion will be moderated by the teacher.

Advanced Seminar on Atomic and Molecular Control Engineering【TACOEN705】

2 credits　Elective Required
Professor Yuji Matsumoto
Associate Professor Shingo Maruyama

Students, through working as a group member of Atomic and Molecular Control Engineering, are expected to develop skills that are required to discuss the research of their doctor's thesis and introduce the latest research papers related to their study.

Advanced Seminar on Resources and Environment【TACOEN706】

2 credits　Elective Required
Professor Keiichi Tomishige
Professor Masaya Mitsuishi
Associate Professor Yoshinao Nakagawa

In this seminar, presentation and discussion will be carried out on the topics related to the doctoral work in the group of Resources and Environment.

Advanced Seminar on Chemistry of Molecular Systems【TACOEN707】

2 credits　Elective Required
Professor Hirotsugu Takizawa
Professor Keisuke Asai
Associate Professor Yamato Hayashi
Associate Professor Yutaka Fujimoto

In this seminar, participants will introduce the research on the structure-property relationship of solid state materials related to their doctoral dissertation and have a high-level discussion based on it. Mainly for students belonging to the Chemistry of Molecular Systems Group.

Advanced Seminar on Control Materials Function【TACOEN708】

2 credits　Elective Required
Prof. Shuichi Oi　Prof. Tomoyuki Akutagawa
Prof. Masaru Nakagawa　Prof. Hiroshi Jinnai
Prof. Hideki Kato　Assoc. Prof. Tomoya Oshikiri
Senior Assistant Prof. Shinya Tanaka
Senior Assistant Prof. Tomohiro Miyata

Introduction of research on Control Materials Function, and discussion based on it.

Presentation and discussion in English on Applied Chemistry, Chemical Engineering, and Biomolecular Engineering【TACOEN711】 2 credits　Elective Required Professor Masaya Mitsuishi Professor Hideyuki Aoki Professor Hitoshi Shiku Associate Professor Fabio Pichierri The aim of this course is to develop language, debate, and communication skills that are sufficient to present and discuss research results related to doctoral dissertation research at international conferences. This training includes actual research presentations and question-and-answer sessions. In addition, group discussions will be held with the aim to prepare the presentation materials necessary for attending international conferences.	**Doctoral Thesis Research in Applied Chemistry【TACOEN709】** 8 credits　Required Subjects Students, through working as a group member of Atomic and Molecular Control Engineering, Resources and Environment, Molecular Chemistry Systems, or Control Materials Function, are expected to develop skills that are required to clearly present and fully discuss about literature and research results.

(DC) Opening of a course class subject list

Department of Chemical Engineering

Category	Subject	Schedule	Language	Credit: Required	Credit: Elective Required	Credit: Elective	Remarks
Interdisciplinary Basic Subjects	Transport Phenomena	Every year	JE		2		Students must get at least 6 credits from the Interdisciplinary Basic Subjects and Related Subjects of Other Majors listed on the left side(2 credits or more from the subjects listed in Interdisciplinary Basic Subjects).
	Advanced Process Analysis and Modeling	Every year	JE		2		
	Advanced Process Unit Operation	Every year	JE		2		
	Advanced Process Systems Engineering	Every year	JE		2		
	Advanced Process Reaction and Separation Processes	Every year	JE		2		
	Doctor Course Special Lectures	Every year	E		2		
Related Subjects of Other Majors	Those approved by the Educational Committee of the Graduate School of Engineering						
Major General Subjects	Advanced Seminar on Transport Phenomena	Every year	JE		2		Students must get 2 credits from the Major General Subjects listed on the left side.
	Advanced Seminar on Chemical Process Engineering	Every year	JE		2		
	Advanced Seminar on Process Systems Engineering	Every year	JE		2		
	Advanced Seminar on Reaction and Separation Processes	Every year	JE		2		
	Presentation and discussion in English on Applied Chemistry, Chemical Engineering, and Biomolecular Engineering	Every year	E		2		
	Doctoral Thesis Research in Chemical Engineering	Every year		8			

1, At least 16 credits must be obtained from the subjects listed in the Interdisciplinary Basic, Major General, and Related Subjects of Other Majors (12 credits or more from the subjects listed in Interdisciplinary Basic and Major General Subjects).

2, "Class Schedule" is currently tentative and may be subject to change.

Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3, Language Key

E: (Lectures given in English)

JE: (Lectures understandable for Japanese and foreign students)

J: (Lectures given in Japanese)

Transport Phenomena【TCEPRE701】

2 credits　Elective Required
Professor Hideyuki Aoki

Transport phenomena, which cover fluid flow, heat transfer, and mass transfer, is fundamental laws for analyzing material recycling systems. The lecture will cover fluid mechanics, thermal engineering, and mass transfer kinetics, as well as combustion engineering, which is an applied technology that combines these three fields.

Advanced Process Analysis and Modeling【TCEOEN710】

2 credits　Elective Required
Prof. Hideyuki Aoki　Prof. Daisuke Nagao
Prof. Naomi Shibasaki-Kitakawa　Prof. Masaki Kubo
Prof. Masaru Watanabe　Prof. Hirotomo Nishihara
Prof. Takaaki Tomai　Assoc. Prof. Keishi Suga
Assoc. Prof. Atsushi Takahashi　Assoc. Prof.Masaki Ota
Senior Assistant Prof. Kazuyuki Iwase

Environmental protection and saving energy are required in industrial processes.　In order to solve these engineering problems, analytical method for the industrial process should be developed using simplified mathematical models based on transport phenomena. The objective of this course is educating for students to review the analytical method for understanding the transport phenomena and achieving low emissions and saving energy in industrial processes.

Advanced Process Unit Operation【TCEOEN711】

2 credits　Elective Required
Professor Daisuke Nagao
Professor Naomi Shibasaki-Kitakawa
Associate Professor Keishi Suga
Associate Professor Atsushi Takahashi

The course provides a broad and deep knowledge of detailed methods for analyzing and designing various elements of chemical processes. In particular, students are taught to seek out technical problems related to the optimal design and planning of unit operations and reactors, and to acquire methodologies for solving them.

Advanced Process Systems Engineering【TCEPRE702】

2 credits　Elective Required
Professor Masaki Kubo

The lecture covers the details of each theoretical system based on specific examples of analysis, design, and control of chemical process system engineering.

Advanced Process Reaction and Separation Processes【TCEOEN712】

2 credits　Elective Required
Prof. Masaru Watanabe　Prof. Hirotomo Nishihara
Prof. Takaaki Tomai　Assoc. Prof.Masaki Ota
Senior Assistant Prof. Kazuyuki Iwase

The course provides broad and deep expertise from a process engineering standpoint on the reaction and separation/purification operations that constitute chemical processes, and examines methods of designing chemical processes in consideration of resource and environmental conservation. Process design including systemization and optimization of reaction and separation operations for the development of rational reaction processes will be the subject of specific lectures. The course will focus on process design, including systemization and optimization of reaction and separation operations for the development of rational reaction processes.

Doctor Course Special Lectures【TCEOEN720】

2 credits　Elective Required
Professor Masaya Mitsuishi
Professor Hideyuki Aoki
Professor Hitoshi Shiku
Associate Professor Fabio Pichierri

A chemistry-related theme will be discussed in each lesson. Students will search information (from papers, books, the Internet, etc.) related to the weekly theme and they will introduce it to the class. Students will use the blackboard to summarize the information delivered to the class and they will make simple drawings of the concepts behind the scientific topic under discussion. All the students in the class will offer comments and questions to the speaker. The discussion will be moderated by the teacher.

Advanced Seminar on Transport Phenomena【TCEOEN715】

2 credits　Elective Required
Professor Hideyuki Aoki

Students who belong to the research group of Transport Phenomena introduce and discuss their thesis research. In addition, the latest related domestic and international research papers are introduced, and exercises are conducted.

Advanced Seminar on Chemical Process Engineering【TCEOEN716】

2 credits　Elective Required
Professor Daisuke Nagao
Professor Naomi Shibasaki-Kitakawa
Associate Professor Keishi Suga
Associate Professor Atsushi Takahashi

Students are expected to give an overview of the research topics in the field of Chemical Process Engineering and to develop discussion skills.

Advanced Seminar on Process Systems Engineering【TCEOEN717】

2 credits　Elective Required
Professor Masaki Kubo
Associate Professor Fabio Pichierri

Students who belong to the research groups of Process Systems Engineering introduce the research involving the doctoral thesis, discuss based on the research, conducted the introduction and exercise the latest research related to their own research.

Advanced Seminar on Reaction and Separation Processes【TCEOEN718】

2 credits　Elective Required
Prof. Masaru Watanabe　Prof. Hirotomo Nishihara
Prof. Takaaki Tomai　Assoc. Prof.Masaki Ota
Senior Assistant Prof. Kazuyuki Iwase

This seminar provides to the group members belong to the Reaction and Separation Processes Group and introduces their doctoral dissertation research, discusses based on the research, and introduces and practices the latest related domestic and international research papers.

Presentation and discussion in English on Applied Chemistry, Chemical Engineering, and Biomolecular Engineering【TCEOEN721】 2 credits　Elective Required Professor Masaya Mitsuishi Professor Hideyuki Aoki Professor Hitoshi Shiku Associate Professor Fabio Pichierri The aim of this course is to develop language, debate, and communication skills that are sufficient to present and discuss research results related to doctoral dissertation research at international conferences. This training includes actual research presentations and question-and-answer sessions. In addition, group discussions will be held with the aim to prepare the presentation materials necessary for attending international conferences.	**Doctoral Thesis Research in Chemical Engineering【TCEOEN719】** 8 credits　Required Subjects Students who belong to the research groups of Energy Process Engineering, Chemical Process Engineering, Process Systems Engineering and Reaction and Separation Processes perform experiment and exercise related to their research themes, including research presentation, discussion, and introduction of research articles.

(DC) Opening of a course class subject list

Department of Biomolecular Engineering

Category	Subject	Schedule	Language	Credit: Required	Credit: Elective Required	Credit: Elective	Remarks
Interdisciplinary Basic Subjects	Genetic Engineering	Every year	JE		2		Students must get at least 6 credits from the Interdisciplinary Basic Subjects and Related Subjects of Other Majors listed on the left side(2 credits or more from the subjects listed in Interdisciplinary Basic Subjects).
	Advanced Biomolecular Engineering	Every year	JE		2		
	Advanced Bioorganic Chemistry	Every year	JE		2		
	Advanced Biofunctional Chemistry	Every year	JE		2		
	Advanced Biological Organic Chemistry	Every year	JE		2		
	Doctor Course Special Lectures	Every year	E		2		
Related Subjects of Other Majors	Those approved by the Educational Committee of the Graduate School of Engineering						
Major General Subjects	Advanced Seminar on Applied Life Chemistry	Every year	JE		2		Students must get 2 credits from the Major General Subjects listed on the left side.
	Advanced Seminar on Bioorganic Chemistry	Every year	JE		2		
	Advanced Seminar on Biofunctional Chemistry	Every year	JE		2		
	Advanced Seminar on Biological Organic Chemistry	Every year	JE		2		
	Presentation and discussion in English on Applied Chemistry, Chemical Engineering, and Biomolecular Engineering	Every year	E		2		
	Doctoral Thesis Research in Biomolecular Engineering	Every year		8			

1, At least 16 credits must be obtained from the subjects listed in the Interdisciplinary Basic, Major General, and Related Subjects of Other Majors (12 credits or more from the subjects listed in Interdisciplinary Basic and Major General Subjects).

2, "Class Schedule" is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.

3, Language Key

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JE: (Lectures understandable for Japanese and foreign students)

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Genetic Engineering【TBEBAB701】

2 credits　Elective Required

Associate Professor Seiji Takahashi

This class subject deals with a variety of genetic and protein engineering approaches, which serve as a basis of biotechnology for the production of useful compounds using enzymatic, microbial, plant and animal cell systems.

Advanced Biomolecular Engineering【TBEOEN720】

2 credits　Elective Required

Prof. Hitoshi Shiku　Prof. Tetsutaro Hattori

Prof. Nobuyuki Uozumi　Prof. Mitsuo Umetsu

Prof. Hitoshi Kasai　Assoc. Prof. Seiji Takahashi

Assoc. Prof. Kohei Ino　Assoc. Prof. Naoya Morohashi

Assoc. Prof. Yasuhiro Ishimaru　Assoc. Prof. Hikaru Nakazawa

Assoc Prof. Hiroya Abe

Senior Assistant Professor Kouki Oka

This lecture will deal with a wide range of research topics concerning basic and advanced aspects of life sciences and their applications. This lecture will also discuss bimolecular engineering issues that remain to be solved and consider how to address these issues scientifically. Such issues, for example, include application of protein synthesis systems for the production of useful compounds.

Advanced Bioorganic Chemistry【TBEAPC701】

2 credits　Elective Required

Prof. Hitoshi Shiku

Prof. Tetsutaro Hattori

Assoc. Prof. Kohei Ino

Assoc. Prof. Naoya Morohashi

Assoc Prof. Hiroya Abe

In biomolecular engineering and related fields, extensive and deep expertise will be given for understanding of the enzyme function and their artificial reproduction and application. Students are required to find out problems at the present stage and consider new methods to solve them, by which problem-finding and task-setting abilities of doctoral students will be developed. Improvement of enzyme functions for biomolecular engineering, development of biofunctional materials, and biosensors for molecular recognition of biomolecules are also the subject of this class.

Advanced Biofunctional Chemistry【TBEBIO701】

2 credits　Elective Required

Professor Nobuyuki Uozumi

Professor Mitsuo Umetsu

Associate Professor Yasuhiro Ishimaru

Associate Professor Hikaru Nakazawa

Lectures on extensive and deep applied biochemistry and biotechnology in bioengineering and related fields are given. Discovering current problems and exploring new problem-solving methods are discussed to train student's problem-finding and setting abilities. Application of the functions of enzymes and genes in living organisms is also discussed.

Advanced Biological Organic Chemistry【TBEAPC702】

2 credits　Elective Required

Professor Hitoshi Kasai

Senior Assistant Professor Kouki Oka

In bioengineering and related fields, lectures will be given on a wide range of specialized knowledge about the organic chemical elucidation of life phenomena and their applications. In addition, the main focus is on cultivating the ability of doctoral course students to find and set up problems by discovering current problems and investigating new problem-solving methods to deal with them. Design and synthesis methods for the creation of new biologically active substances will also be the subject of specific research.

Doctor Course Special Lectures【TBEOEN728】

2 credits　Elective Required

Professor Masaya Mitsuishi

Professor Hideyuki Aoki

Professor Hitoshi Shiku

Associate Professor Fabio Pichierri

A chemistry-related theme will be discussed in each lesson. Students will search information (from papers, books, the Internet, etc.) related to the weekly theme and they will introduce it to the class. Students will use the blackboard to summarize the information delivered to the class and they will make simple drawings of the concepts behind the scientific topic under discussion. All the students in the class will offer comments and questions to the speaker. The discussion will be moderated by the teacher.

Advanced Seminar on Applied Life Chemistry【TBEOEN723】

2 credits　Elective Required

Associate Professor Seiji Takahashi

Students will be assigned to the Applied Life Chemistry group and discuss the results and perspectives of their doctoral thesis research. They will also have seminars concerning recent advances of related research field by using recently published papers.

Advanced Seminar on Bioorganic Chemistry【TBEOEN724】

2 credits　lective Required

Prof. Hitoshi Shiku

Prof. Tetsutaro Hattori

Assoc. Prof. Kohei Ino

Assoc. Prof. Naoya Morohashi

Assoc. Prof. Hiroya Abe

Belonging to the Bioorganic Chemistry Group, we will introduce the research contents related to doctoral dissertation research, discuss based on it, and practice the introduction of representative or latest domestic and foreign research papers related to the same theme.

Advanced Seminar on Biofunctional Chemistry【TBEOEN725】 2 credits　Elective Required Professor Nobuyuki Uozumi Professor Mitsuo Umetsu Associate Professor Yasuhiro Ishimaru Associate Professor Hikaru Nakazawa Belonging to the Biofunctional Chemistry Group, we will introduce the research contents related to doctoral thesis research, discuss based on it, and practice related representative or latest domestic and foreign research papers on the same theme.	**Advanced Seminar on Biological Organic Chemistry【TBEOEN726】** 2 credits　Elective Required Professor Hitoshi Kasai Senior Assistant Professor Kouki Oka Belonging to the bioengineering group, we will introduce research contents related to doctoral dissertation research, discuss based on it, and introduce representative or latest domestic and foreign research papers related to the same theme.
Presentation and discussion in English on Applied Chemistry, Chemical Engineering, and Biomolecular Engineering【TBEOEN729】 2 credits　Elective Required Professor Masaya Mitsuishi Professor Hideyuki Aoki Professor Hitoshi Shiku Associate Professor Fabio Pichierri The aim of this course is to develop language, debate, and communication skills that are sufficient to present and discuss research results related to doctoral dissertation research at international conferences. This training includes actual research presentations and question-and-answer sessions. In addition, group discussions will be held with the aim to prepare the presentation materials necessary for attending international conferences.	**Doctoral Thesis Research in Biomolecular Engineering【TBEOEN727】** 8 credits　Required Subjects Students who belong to research groups of Applied Life Chemistry, Bioorganic Chemistry, and Biofunctional Chemistry perform experiments and exercises related to their research themes, such as research presentation, discussion, and introduction of research articles.

授業科目表（DC）Opening of a course class subject list

Department of Metallurgy

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	材料社会学特論 Advanced Social Engineering for Material Engineers				2		
	環境材料学特論 Ecomaterials Science				2		
	金属プロセス工学特論 Metallurgical Process Engineering				2		
	創形創質プロセス学特論 Materials Forming and Stuructural Control				2		
	先端マテリアル物理化学特論 Advanced Materials Physical Chemistry				2		
	プロセス設計学特論 Advanced Course on Material Processing		J		2		
	プロセス制御学特論 Control of Materials Processes				2		
	金属プロセス工学特論 Metallurgical Process Engineering		E		2		
	材料理化学特論 Advanced Course on Materials Physical Chemistry		E		2		
	インターンシップ研修 Internship training				1~2		
	金属フロンティア工学特別講義 Special Lecture on Metallurgy						
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	金属プロセス工学特別研修 Advanced Seminar on Metallurgical Process Engineering	every year			4		
	創形創質プロセス学特別研修 Advanced Seminar on Materials Forming and Structural Control	every year			4		
	先端マテリアル物理化学特別研修 Advanced Seminar on Materials Physical Chemistry	every year			4		
	プロセス設計学特別研修 Advanced Seminar on Material Processing Design	every year			4		
	プロセス制御学特別研修 Advanced Seminar on Materials Processing Control	every year			4		
	金属フロンティア工学博士研修 Research for Doctoral Thesis in Metallurgy	every year			8		

1，上記科目の単位数を合わせて 16 単位以上を修得すること。
Students must acquire 16 or more credits from the subjects above.
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

＜金属フロンティア工学／Metallurgy＞

Advanced Social Engineering for Material Engineers 2 credits
材料社会学特論
Elective Required
Prof. Akira Nagamatsu

This course aims to integrate theory and practice in innovation by explaining the latest papers and research results in the management of companies related to technology and innovation.

Ecomaterials Science 2 credits
環境材料学特論
Elective Required
Prof. Tomomasa Wadayama, Shin-ichi Orimo, Taichi Murakami

Following lectures will open every third year.
1. The methods of the quantitative analysis and evaluation for the influence of major material processes on the global environment will be studied on the bases of basic sciences, e.g., physical chemistry, transport phenomena and chemical reaction engineering. The measures to build an environmentally compatible process and to remove environmental pollutants discharged from various processes will be introduces and the significances of recycling and separation technologies will be learned.
2. This lecture describes the principle and the actual application of several analytical methods, employed in a life cycle of metallic materials, such as selection of the resources, production of raw materials and final products, and scrapping of them. Especially, it is explained how the analytical methods contribute to reduction in the environmental loading, saving of energy, and recycling of metallic materials.
3. This course provides an overview of various functions for eco-friendly materials, so that students understand principles of material's functionalization.
The lectures explain reduction in environmental burden through fabrications of high-strength and high-heat-resisting materials, synthesis of functionalized fine particles to create clean-energy, materials functionalization through mechanochemistry, and design concept of eco-friendly materials, etc.

Metallurgical Process Engineering 2 credits
金属プロセス工学特論
Elective Required
Prof. Takahiro Miki

Development of processes for high purity steel, non-ferrous metals and various materials, under consideration of minimization of energy consumption, resource conservation, recycling, and ultimately emission minimization with closed systems is the target. Focusing on basic principles and the design of optimal processes, lectures are given based on chemical reaction theory, reaction kinetics, thermal engineering, transport theory, process engineering, measurement engineering, etc.

Materials Forming and Stuructural Control 2 credits
創形創質プロセス学特論
Elective Required
Prof. Ryosuke Kainuma, Toshihiro Ohmori, Katsunari Oikawa

In the future of materials manufacturing, it is necessary to comprehensively study the process design from raw materials to final products, taking into account the environment and energy efficiency, as well as materials science research on the nano level to the micro and macro scales. In this special lecture, we will lecture on the results of research on new manufacturing processes that use methods such as computer simulation technology and process modeling, in a comprehensive academic field based on materials science and process engineering.

Advanced Materials Physical Chemistry 2 credits
先端マテリアル物理化学特論
Elective Required
Prof. Hongming Zhu

The improvement of production process of industrial materials represented by metals and the development of advanced materials require a comprehensive analysis on the macroscopic physicochemical properties of high-temperature melts and on the microscopic phenomena in interfaces between different phases. This lecture covers chemical thermodynamics, physicochemical properties of melts, surface phenomena and their measurement methods, and applications.

Advanced Course on Material Processing Design 2 credits
プロセス設計学特論
Elective Required
Prof. Hiroyuki Shibata, Shigeru Ueda

We will introduce the results of widely conducted research on the analysis and optimization of various phenomena related to the refining and solidification processes of metals, especially steel materials, and conduct doctoral training on future issues and solutions.

Control of Materials Processes 2 credits
プロセス制御学特論
Elective Required
Prof. Tadashi Furuhara, Tetsu Ichitsubo, Hirosi Nogami, Yukio Takahashi

This lecture deals with developments and controls of various materials production/synthesis processes based on advanced process engineering techniques. It is important, for developing new processes, to study the properties of produced materials and to examine effects of the processes applied to raw materials. Attentions should be also paid to energy consumption or materials recycling in consideration of environmental impacts in materials production. For these purposes, fundamental principles such as equilibrium or non-equilibrium thermodynamics, kinetics in transport phenomena, crystallographic and electronic structures, as well as theoretical/experimental or scientific/engineering methodologies are introduced in more advanced manners.

Metallurgical Process Engineering 2 credits
金属プロセス工学特論
Elective Required
All Professors

This lecture will deal with the process of material pro- duction. Focus will be placed on thermodynamics, physico- chemical properties interfacial phenomena, solidification material processing metallurgical processes, and the envi- ronmental problems related to the current processes.

Advanced Course on Materials Physical Chemistry 2 credits 材料理化学特論 Elective Required Prof. Hongmin Zhu This lecture deals with fundamental and applied physical chemistry based on the statistical mechanics, chemical thermodynamics, thermophysics, electrochemistry, X-ray scattering, high energy beam and surface treatment, and is focused on various materials such as molten metals and salts, high purity metals, semiconductors, metallic compounds, nano-materials, biomaterials, non-equilibrium materials, surface and interfaces	**Internship Training** 1-2 credits インターンシップ研修 Elective Required Practical training and research activities will be conducted at companies as hands-on exercises for about 2 weeks to 1 month.
Special Lecture on Metallurgy 金属フロンティア工学特別講義 Elective Required This is a special lecture that introduces the latest academic research results in specialized fields and related fields, and aims to promote specialized knowledge about doctoral thesis and to create and develop academic fields.	**Advanced Seminar on Metallurgical Process Engineering** 金属プロセス工学特別研修 Elective Required 4 credits Prof. Takahiro Miki This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in Metallurgical Process Engineering. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.
Advanced Seminar on Materials Forming and Structural Control 創形創質プロセス学特別研修 4 credits Elective Required Prof. Ryosuke Kainuma, Toshihiro Ohmori, Katsunari Oikawa Introducing research related to doctoral dissertation research in the Creation and Creation Process Science Group, discussions based on them, and introducing and practicing the latest domestic and foreign research papers related.	**Advanced Seminar on Materials Physical Chemistry** 4 credits 先端マテリアル物理化学特別研修 Elective Required Prof. Hongmin Zhu, Associate Prof. Osamu Takeda This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in Materials Physical Chemistry Group. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.
Advanced Seminar on Material Processing Design 4 credits プロセス設計学特別研修 Elective Required Prof. Hiroyuki Shibata, Shigeru Ueda, Associate Prof. Sohei Sukenaga This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in Material Processing Design Group. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.	**Advanced Seminar on Materials Processing Control** 4 credits プロセス制御学特別研修 Elective Required Prof. Tadashi Furuhara, Tetsu Ichitsubo, Hiroshi Nogami, Yukio Takahashi Associate Prof. Goro Miyamoto, Norihiko Okamoto, Shungo Natsui, Kozo Shinoda This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in Process Control for Materials Processing Group. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.
Research for Doctoral Thesis in Metallurgy 8 credits 金属フロンティア工学博士研修 Elective Required All Professors Students belonging to each group of metal process engineering, creative creation process science, advanced material physical chemistry, process design science, and process control science conduct experiments and exercises such as research, research presentations, discussions, and literature introductions.	

授業科目表（DC）Opening of a course class subject list

Department of Materials Science

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	材料社会学特論 Advanced Social Engineering for Material Engineers				2		
	環境材料学特論 Ecomaterials Science				2		
	材料電子工学特論 Advanced Materials Electrochemistry				2		
	ナノ材料物性学特論 Advanced Topics on Nanoscale Materials Physics				2		
	情報デバイス材料学特論 Materials and Devices for Information Technology		JE		2		
	ナノ構造物質工学特論 Advanced Studies on Nano-Structured Materials				2		
	物質機能創製学特論 Topics on Material Function and Synthesis				2		
	高機能材料学特論 Advanced Topics on High Performance Materials		E		2		
	物性制御学特論 Advanced Topics on Highly Sophisticated Materials		E		2		
	インターンシップ研修 Internship training				1~2		
	知能デバイス材料学特別講義 Special Lecture on Materials Science						
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	材料電子化学特別研修 Advanced Seminar on Materials Electrochemistry	every year			4		
	ナノ材料物性学特別研修 Advanced Seminar on Nanomaterials Science	every year			4		
	情報デバイス材料学特別研修 Advanced Seminar on Materials and Devices for Information Technology	every year			4		
	ナノ構造物質工学特別研修 Advanced Seminar on Nano-Structured Materials	every year			4		
	物質機能創製学特別研修 Advanced Seminar on Materials Function and Synthesis	every year			4		
	知能デバイス材料学博士研修 Research for Doctoral Thesis in Materials Science	every year			8		

1, 上記科目の単位数を合わせて 16 単位以上を修得すること。
Students must acquire 16 or more credits from the subjects above.
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J:日本語開講科目（Lectures given in Japanese）

＜知能デバイス材料学／Materials Science＞

Advanced Social Engineering for Material Engineers **材料社会学特論** 2 credits Elective Required Prof. Akira Nagamatsu This course aims to integrate theory and practice in innovation by explaining the latest papers and research results in the management of companies related to technology and innovation.	**Ecomaterials Science** 2 credits **環境材料学特論** Elective Required Prof. Tomomasa Wadayama, Shin-ichi Orimo, Taichi Murakami Following lectures will open every third year. 1. The methods of the quantitative analysis and evaluation for the influence of major material processes on the global environment will be studied on the bases of basic sciences, e.g., physical chemistry, transport phenomena and chemical reaction engineering. The measures to build an environmentally compatible process and to remove environmental pollutants discharged from various processes will be introduces and the significances of recycling and separation technologies will be learned. 2. This lecture describes the principle and the actual application of several analytical methods, employed in a life cycle of metallic materials, such as selection of the resources, production of raw materials and final products, and scrapping of them. Especially, it is explained how the analytical methods contribute to reduction in the environmental loading, saving of energy, and recycling of metallic materials. 3. This course provides an overview of various functions for eco-friendly materials, so that students understand principles of material's functionalization. The lectures explain reduction in environmental burden through fabrications of high-strength and high-heat-resisting materials, synthesis of functionalized fine particles to create clean-energy, materials functionalization through mechanochemistry, and design concept of eco-friendly materials, etc.
Advanced Materials Electrochemistry 2 credits **材料電子化学特論** Elective Required Prof. Izumi Muto This lecture will deal with various topics on electrochemistry in the advanced fields of materials science, and will mainly be focused on several topics such as corrosion-resistant materials. semiconductor electrodes, surface characterization, and electrochemical methods.	**Advanced Topics on Nanoscale Materials Physics** 2 credit **ナノ材料物性学特論** Elective Required Prof. Kyosuke Yoshimi, Yuji Sutou The development of novel nanomaterials utilizing unique functional properties that cannot be obtained in conventional bulk materials is very important to support the remarkable technological advances in recent years. This course covers a comprehensive foundation of basics and applications that provide design and guidelines for the development of novel nanomaterials, including quantum, electronic, and magnetic properties, local properties at nano and atomic level under extreme conditions related to diffusion, and surface and interface properties of nanoscale thin films and fine particles.
Materials and Devices for Information Technology 2 credit **情報デバイス材料学特論** Elective Required Prof. Makoto Kohda, Hitoshi Takamura In the advanced information society of the 21st century, novel materials and devices related to communication, information, and energy will become increasingly important. This lecture will give the basic principles of materials and devices such as electronics, optical communications, optoelectronics, spintronics that have the potential to create devices based on new principles, nanotechnology and atom technology that aim at the limit of miniaturization. In addition, materials for large-capacity energy storage and conversion, such as secondary batteries, fuel cells, and solar cells, which are indispensable for efficient and long-term operation of information device equipment, will be explained.	**Advanced Studies on Nano-Structured Materials** 2 credit **ナノ構造物質工学特論** Elective Required Prof. Kazumasa Sugiyama, Hidemi Kato, Momoji Kubo, Junji Saida Material science has advanced to the challenging field of nano-structure. This course, coordinated by four lecturers who are experts in manufacturing processes, physical and chemical properties, and structural characterization of advanced materials with controlled nanostructures, aims to provide useful guidelines for the use of nanostructured materials. Part 1: Part 1 describes methods for characterizing the atomic-level structure of amorphous and nanostructured materials. Advanced structural characterization using quantum beams will also be introduced. (Sugiyama) Part 2: Part 2 describes various dealloying methods to produce 3D bicontinuous nanoporous and composite alloys by self-organizing metallurgical reaction. Their possible applications will be also introduced. Part 3: Part 3 describes the nanostructures of advanced materials as well as their physical and chemical properties revealed by computational science simulations using supercomputer. Part 4: Part 4 studies various and fundamental properties of metallic glasses, and explains mainly the relaxation-rejuvenation phenomenon as atomiclevel glassy structural control to introduce examples of improvement of mechanical properties. (Saida)

Topics on Material Function and Synthesis 2 credits
物質機能創製学特論
Elective Required
Prof. Atsushi Momose, Junji Saida, Yuta Saito

Exploring novel material functions has been supported by progresses in various scientific fields. In this academic year, this lecture picks up three themes: local structures and relaxation state control of non-crystalline materials, material exploring and functional modification by laser, and structural and functional evaluation by X-rays. It will also introduce state-of-art researches in each field.

Advanced Topics on High Performance Materials 2 credits
高機能材料学特論
Elective Required
Prof. Yuji Sutou, Satoshi Sugimoto, Hitoshi Takamura

This lecture will deal with various aspects of high performance functional materials from fundamentals to advanced subjects. They cover topics on structural materials, materials for information technologies electronics, optoelectronics and spin-electronics, and materials for energy conversion with respect to metals, semiconductors and ceramics.

Advanced Topics on Highly Sophisticated Materials 2 credits
物性制御学特論
Elective Required
Prof. Atsushi Momose

This lecture will deal with various topics on highly sophisticated materials in the advanced fields of materials science, and will mainly be focused on several topics such as electronic and magnetic materials, optic materials, functional materials, superlattices, surface characterization, microstructural control.

Internship Training 1～2 credits
インターンシップ研修
Elective Required

Practical training and research activities will be conducted at companies as hands-on exercises for about 2 weeks to 1 month.

Special Lecture on Materials Science
知能デバイス材料学特別講義
Elective Required

This is a special lecture that introduces the latest academic research results in specialized fields and related fields, and aims to promote specialized knowledge about doctoral thesis and to create and develop academic fields.

Advanced Seminar on Materials Electrochemistry 4 credits
材料電子化学特別研修
Elective Required
Prof. Izumi Muto, Associate Prof. Yu Sugawara

This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in materials electrochemistry. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.

Advanced Seminar on Nano-materials Science 4 credits
ナノ材料物性学特別研修
Elective Required
Prof. Yuji Sutou, Kyosuke Yoshimi
Associate Prof. Nobuaki Sekido, Daisuke Ando

Introducing research related to doctoral dissertation research in the Nanomaterials Condensed Matter Physics Group, discussions based on them, and introducing and practicing the latest domestic and foreign research papers related.

Advanced Seminar on Materials and Devices for Information Technology 4 credits
情報デバイス材料学特別研修
Elective Required
Prof. Makoto Kohda, Satoshi Sugimoto, Hitoshi Takamura
Associate Prof. Nobuki Tezuka,
Lecturer, Masashi Matsuura

This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in materials and devices for information technology. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.

Advanced Seminar on Nano-Structured Materials 4 credits
ナノ構造物質工学特別研修
Elective Required
Prof. Kazumasa Sugiyama, Hidemi Kato, Momoji Kubo, Junji Saida
Associate Prof. Takeshi Wada, Yusuke Ootani, Yayoi Terada,
Rodion Belosludov

Introducing research related to doctoral dissertation research in the Nanostructure Materials Engineering Group, discussions based on them, and introducing and practicing the latest domestic and foreign research papers related.

Advanced Seminar on Materials Function and Synthesis 4 credits
物質機能創製学特別研修
Elective Required
Prof. Atsushi Momose, Associate Prof. Yoshitika Seki, Yuta Sato

This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in materials function and syntheaia.
Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.

Research for Doctoral Thesis in Materials Science 8 credits
知能デバイス材料学博士研修
Elective Required
All Professors

Students belonging to each group of materials electronic chemistry, nanomaterials condensed matter physics, information device materials science, nanostructure material engineering, material function creation science, material surface function control science, research, research presentation, discussion, literature introduction, etc. Experiments and exercises.

授業科目表（DC）Opening of a course class subject list

Department of Materials Pricessing

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	 選択必須 Elective Required	 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	材料社会学特論 Advanced Social Engineering for Material Engineers				2		
	環境材料学特論 Advanced Social Engineering for Material Engineers				2		
	接合界面制御学特論 Interface Science and Engineering of Joining				2		
	マイクロシステム学特論 Advanced Microsystems Design and Processing				2		
	生体材料システム学特論 Advanced Course on Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems				2		
	物質構造評価学特論 Advanced Structural Characterization of Materials				2		
	材料機能制御プロセス学特論 Processing for Materials Function Control				2		
	材料システム工学特論 Advanced Materials Processing		JE		2		
	インターンシップ研修 Internship traning				1~2		
	材料システム工学特別講義 Special Lecture on Materials Processing						
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	接合界面制御学特別研修 Advanced Seminar on Interface Science and Engineering of Joining	every year			4		
	マイクロシステム学特別研修 Advanced Seminar on Microsystems Design and Processing	every year			4		
	生体材料システム学特別研修 Advanced Seminar on Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems	every year			4		
	物質構造評価学特別研修 Advanced Seminar on Structural Characterization of Materials	every year			4		
	材料機能制御プロセス学特別研修 Advanced Seminar on Processing for Materials Function Control	every year			4		
	材料システム工学博士研修 Research for Doctoral Thesis in Materials Processing	every year			8		

1，上記科目の単位数を合わせて 16 単位以上を修得すること。
Students must acquire 16 or more credits from the subjects above.
2,『開講時期』については、現時点におけるものであり、変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

＜材料システム工学／Materials Processing＞

Advanced Social Engineering for Material Engineers 2 credits
材料社会学特論
Elective Required
Prof. Akira Nagamatsu

This course aims to integrate theory and practice in innovation by explaining the latest papers and research results in the management of companies related to technology and innovation.

Ecomaterials Science 2 credits
環境材料学特論
Elective Required
Prof. Tomomasa Wadayama, Shin-ichi Orimo, Taichi Murakami

Following lectures will open every third year.
1. The methods of the quantitative analysis and evaluation for the influence of major material processes on the global environment will be studied on the bases of basic sciences, e.g., physical chemistry, transport phenomena and chemical reaction engineering. The measures to build an environmentally compatible process and to remove environmental pollutants discharged from various processes will be introduces and the significances of recycling and separation technologies will be learned.
2. This lecture describes the principle and the actual application of several analytical methods, employed in a life cycle of metallic materials, such as selection of the resources, production of raw materials and final products, and scrapping of them. Especially, it is explained how the analytical methods contribute to reduction in the environmental loading, saving of energy, and recycling of metallic materials.
3. This course provides an overview of various functions for eco-friendly materials, so that students understand principles of material's functionalization.
The lectures explain reduction in environmental burden through fabrications of high-strength and high-heat-resisting materials, synthesis of functionalized fine particles to create clean-energy, materials functionalization through mechanochemistry, and design concept of eco-friendly materials, etc.

Interface Science and Engineering of Joining 2 credits
接合界面制御学特論
Elective Required
Prof. Yutaka Sato

Many industrial products are inevitably assembled by welding, joining and bonding processes. It is well known that the service limits of the products are directly related to properties and reliabilities of the welded parts are generally weakest in the products. In this course, lecture on strategy of the control and design of the microstructure at the welded interfaces and parts with better properties and higher reliability during welding, joining and bonding processes will be given.

Advanced Microsystems Design and Processing 2 credits
マイクロシステム学特論
Elective Required
Prof. Naoyuki Nomura, Yoshikazu Ohara, Chaonan Xu

The course will cover the mechanisms of functionality of material systems, micro- and macro-mechanical analysis of static and dynamic properties under complex environments, and microparticle fabrication processes for building material systems. Students will gain extensive and in-depth expertise in mechanical, optical, and ultrasonic characteristics of materials fabricated by state-of-the-art fabrication processes.

Advanced Course on Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems 2 credits
材料機能制御プロセス学特論
Elective Required
Prof. Masaya Yamamoto, Takayuki Narushima

The lecture covers the properties, design, fabrication, and systemization of biomaterials including metals, ceramics, polymers, and nano-organic materials that support advanced medicine, based on biofunctions, surface/interface reactions, physical chemistry, molecular science, and ecological impact assessment.

Advanced Structural Characterization of Materials 2 credits
物質構造評価学特論
Elective Required
Prof. Satoshi Kameoka, Takahiro Yamada

The compositional analysis and morphological evaluation of materials with high purity and precisely controlled morphology using advanced analytical methods such as optical absorption spectrum analysis, X-ray diffraction, and high-resolution microscopic observation, as well as crystal engineering, surface analysis, and radiation diffraction for various instrumental analyses will be lectured.

Processing for Materials Function Control 2 credits
材料機能制御プロセス学特論
Elective Required
Prof. Akira Yoshikawa, Yu Kumagai, Rie Umetsu,
Kenji Tsuda, Hiroshi Masumoto

The lecture will focus on the structural and microstructural dependence of mechanical and physical properties of advanced materials. Topics include the establishment of forming process technologies with controllable structure and microstructure for the development of highly functional materials, analysis of nano-, micro-, meso-, and macrostructural changes that occur during processing, and the creation of databases of such data.

Advanced Materials Processing 2 credits
材料システム工学特論
Elective Required
All Professors

The lecture deals with a wide range of materials processing from basic knowledge to advanced subjects. It is intensively focused on several topics of functions of material systems, applied elasticity and plasticity, numerical analysis of materials processing, structural characterization of materials, powder process technology, materials engineering in processing, evaluation of material systems, liquid state processing, and joining science and technology.

Internship Training 1～2 credits
インターンシップ研修
Elective Required

Practical training and research activities will be conducted at companies as hands-on exercises for about 2 weeks to 1 month.

Special Lecture on Materials Processing
材料システム工学特別講義
Elective Required

This is a special lecture that introduces the latest academic research results in specialized fields and related fields, and aims to promote specialized knowledge about doctoral thesis and to create and develop academic fields.

Advanced Seminar on Interface Science and Engineering of Joining 接合界面制御学特別研修 4 credits Elective Required Prof. Yutaka Sato Inquire about research related to doctoral dissertation research in joint interface control, discuss based on them, and introduce and practice the latest domestic and foreign research papers related to them.	**Advanced Seminar on Microsystems Design and Processing** マイクロシステム学特別研修 4 credits Elective Required Prof. Naoyuki Nomura, Associate Prof. Zhou Weiwei Introduce research related to doctoral dissertation research in the Microsystems Group, discuss based on them, and introduce and practice the latest domestic and foreign research treatises related to them.
Advanced Seminar on Physical Metallurgy and Physicochemistry of Biomolecular and Biomaterial Systems 4 credits 生体材料システム学特別研修 Elective Required Prof. Masaya Yamamoto, Takayuki Narushima Associate Prof. Kyosuke Ueda Introducing research related to doctoral dissertation research in the Biomaterials Systems Group, discussions based on them, and introducing and practicing the latest domestic and foreign research papers related.	**Advanced Seminar on Structural Characterization of Materials** 物質構造評価学特別研修 4 credits Elective Required Prof. Takahiro Yamada, Satoshi Kameoka Lecturer. Nobuhisa Fujita This lecture deals introduces the latest domestic and foreign research reported in doctoral dissertations in the groupe of the materials crystallography. Students will learn the background to these studies, engage in discussion, and complete an exercise based on them.
Advanced Seminar on Processing for Materials Function Control 材料機能制御プロセス学特別研修 4 credits Elective Required Prof. Akira Yoshikawa, Yu Kumagai, Rie Umetsu, Kenji Tsuda, Hiroshi Masumoto, Introducing research related to doctoral dissertation research in the Material Function Control Processes Group, discussions based on them, and introducing and practicing the latest domestic and foreign research papers related.	**Research for Doctoral Thesis in Materials Processing** 6 credits 材料システム工学博士研修 Elective Required All Professors Students belonging to each group of junction interface control science, microsystem science, biomaterial system science, material structure evaluation science, and material function control process science conduct experiments and exercises such as research, research presentations, discussions, and literature introductions.

授業科目表（DC）Opening of a course class subject list

Department of Civil and Environmental Engineering

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	 選択必須 Elective Required	 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	Advanced Mathematical System Design		JE		2		At least 6 credits must be earned in total from the interdisciplinary basic subjects and related subjects of other majors listed on the left.
	Advanced Infrastructural Materials		JE		2		
	Advanced Civil Engineering Structures		JE		2		
	Advanced Environmental Hydraulics and Water Quality Engineering		JE		2		
	Advanced Regional System Engineering		JE		2		
	Disaster Control Engineering		JE		2		
	Special Lecture on Civil and Environmental Engineering				…		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	Advanced Seminar on Mathematical System Design				2		At least 2 credits must be earned from the major general subjects listed on the left.
	Advanced Seminar on Infrastructural Materials				2		
	Advanced Seminar on Civil Engineering Structures				2		
	Advanced Seminar on Hydraulics and Environmental Engineering				2		
	Advanced Seminar on Regional System Engineering				2		
	Doctoral Thesis Research in Civil and Environmental Engineering			8			

1，所属専攻の学際基盤科目，専門科目及び関連科目の単位数を合わせて 16 単位以上（うち，学際基盤科目及び関連科目を合わせて６単位以上）修得すること。

Students must acquire 16 or more credits from the interdisciplinary basic subjects, major general subjects, and related subjects of other majors (including 6 or more credits from the interdisciplinary basic subjects and related subjects of other majors).

2,『開講時期』欄において，『毎年』は毎年開講，『隔年』は隔年開講科目，記載のない科目は集中講義として短期間に集中して開講する科目を指す。開講年度はガイダンス時に確認すること。

In the "Schedule" column, "Every year" refers to courses offered every year, "Alternate year" refers to courses offered alternate year, and courses without a description refer to courses that are offered intensively over a short period as intensive courses. Make sure to check the course year at the time of course guidance.

3,「使用言語」欄のアルファベット記号について

Language Key

J:日本語開講科目(Lectures given in Japanese)

E:英語開講科目(Lectures given in English)

JE:準英語開講科目(Lectures basically given in Japanese, with additional explanations or material in English for foreign students.)

Advanced Mathematical System Design 2 credits
Elective Required
Professor Yuki Yamakawa

This course aims to learn theoretical and computational methodologies for predicting and evaluating the strength and stability of structural systems, and the deformation and failure characteristics of materials using the approach based on continuum mechanics, elastoplasticity theory, and computational mechanics. Through these studies, students will acquire advanced knowledge in solving various mechanical problems involved in the design, maintenance, and management of infrastructures with robustness, resilience, and longevity. The topics covered in this class encompass the constitutive theory for finite deformations, bifurcation and instability phenomena in materials and structures, as well as damage mechanisms and repair techniques of infrastructures.

Advanced Infrastructural Materials 2 credits
Elective Required
Professor Motoki Kazama, Professor Takashi Kyoya, Professor Makoto Hisada, Professor Kenjiro Terada, Associate Professor Hiroshi Minagawa, Associate Professor Shuji Moriguchi, Associate Professor Shotaro Yamada, Associate Professor Akiyoshi Kamura, Associate Professor Shintaro Miyamoto

This lecture will cover the following topics: Advanced mechanical theories for analysis and design of civil engineering structures and materials used for their foundations, development of new materials and their application methods, maintenance methods of materials, and materials science environmental issues.

Advanced Civil Engineering Structures 2 credits
Elective Required
Professor Shigeki Unjoh, Associate Professor Isao Saiki, Associate Professor Hideki Naito

Students will be taught the structural and material concepts of civil engineering structures with high performance, high reliability and high durability, as well as the analytical and design methods, based on the understanding of the relation between structural responses against various environmental actions and the strength/ductility characteristics.

Advanced Environmental Hydraulics and Water Quality Engineering
Elective Required 2 credits
Professor So Kazama, Professor Yu-You Li, Professor Daisuke Sano, Professor Fumihiko Imamura, Professor Shunichi Koshimura, Professor Keiko Udo, Associate Professor Kengo Kubota, Associate Professor Daisuke Komori, Associate Professor Anawat Sappasri

This Advanced course focuses on water-related environments and ecosystems in the atmosphere, hydrosphere, geosphere, and biosphere. Interactions among the water environment, energy cycle, material cycle, and human society will be discussed from the viewpoints of both the quality and movement of water. Furthermore, methods to elucidate the elementary processes and system dynamics will be lectured.

Advanced Regional System Engineering 2 credits
Elective Required
Professor Osamu Nishimura, Professor Makoto Okumura, Associate Professor Katsuya Hirano, Associate Professor Takashi Sakamaki, Associate Professor Yu Otake

This advanced course takes an integrated view of regional social infrastructure, socio-economic systems, and environmental systems in the atmosphere, water, and soil spheres from the global environment to the urban environment. Comprehensive regional planning, selection and evaluation of measures focusing on the interaction of land use, transportation, and the environment are considered. Furthermore, the latest research results on artificial tidal flats, artificial seaweed beds, artificial beaches, technologies for improving circulation in lakes and rivers, and bioremediation technologies for groundwater, which are necessary for environmental conservation and restoration technologies, will be lectured.

Disaster Control Engineering 2 credits
Elective Required
Professor Fumihiko Imamura, Professor Shunichi Koshimura

The purpose of this lecture is to acquire basic skills for conducting state-of-the-art research in the field of disaster control. The latest research in this field will be introduced, and an overview, basic theory, and problems will be lectured. Through lectures and assignments, students will understand the rationality of research and the importance of originality and ingenuity and will be trained to formulate research plans based on logical thinking.

Special Lecture on Civil and Environmental Engineering 2 credits
Elective Required

This special lecture introduces the latest academic research or the creation and development of an academic discipline in a specialized field.

Advanced Seminar on Mathematical System Design 2 credits
Elective Required
Professor Yuki Yamakawa

In this seminar, students in the mathematical system design group will introduce and discuss their doctoral thesis research and the latest related domestic and international research papers.

Advanced Seminar on Infrastructural Materials 2 credits

Elective Required

Professor Motoki Kazama, Professor Takashi Kyoya, Professor Makoto Hisada, Professor Kenjiro Terada, Associate Professor Hiroshi Minagawa, Associate Professor Shuji Moriguchi, Associate Professor Shotaro Yamada, Associate Professor Akiyoshi Kamura, Associate Professor Shintaro Miyamoto

In this seminar, students in the infrastructural materials group will introduce and discuss their doctoral thesis research and the latest related domestic and international research papers.

Advanced Seminar on Civil Engineering Structures 2 credits

Elective Required

Professor Shigeki Unjoh, Associate Professor Isao Saiki, Associate Professor Hideki Naito

In this seminar, students in the civil engineering structures will introduce and discuss their doctoral thesis research and the latest related domestic and international research papers.

Advanced Seminar on Hydraulics and Environmental Engineering

Elective Required 2 credits

Professor So Kazama, Professor Yu-You Li, Professor Daisuke Sano, Professor Fumihiko Imamura, Professor Shunichi Koshimura, Professor Keiko Udo, Associate Professor Kengo Kubota, Associate Professor Daisuke Komori, Associate Professor Anawat Sappasri

In this seminar, students in the hydraulics and environmental engineering group will introduce and discuss their doctoral thesis research and the latest related domestic and international research papers.

Advanced Seminar on Regional System Engineering 2 credits

Elective Required

Professor Osamu Nishimura, Professor Makoto Okumura, Associate Professor Katsuya Hirano, Associate Professor Takashi Sakamaki, Associate Professor Yu Otake

In this seminar, students in the regional system engineering group will introduce and discuss their doctoral thesis research and the latest related domestic and international research papers.

Doctoral Thesis Research in Civil and Environmental Engineering

Required 2 credits

All teachers

In this seminar, students in each study group, such as Mathematical System Design, Infrastructural Materials, Civil Engineering Structures, Hydraulics and Environmental Engineering, and Regional System Engineering, will explain and discuss their research, introduce the related papers, and conduct experiments and practices.

授業科目表（DC）Opening of a course class subject list

Department of Architecture and Building Science

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	都市・建築デザイン学特論 Advanced Course on Architecture and Urban Design	毎年 Every Year	JE		2		左記の学際基盤科目および関連科目のうちから，4 単位以上を選択履修すること。 ただし，上記 4 単位に含めることができるインターンシップ研修 B 及び関連科目は 2 単位までとする。 Students must acquire 4 or more credits from the interdisciplinary basic subjects and related subjects listed on the left. However, Internship Training B and related subjects which may be included in the above 4 credits are limited to 2 credits.
	都市・建築計画学特論 Advanced Course on Architecture and Urban Planning	毎年 Every Year	JE		2		
	サステナブル空間構成学特論 Advanced Course on Sustainable Architecture and Building Science	毎年 Every Year	JE		2		
	建築構造工学特論 Advanced Course on Structural Engineering for Architecture	毎年 Every Year	JE		2		
	建築環境デザインのための CFD モデリング CFD Modeling for Building Environment Design	3 年に 1 回 Every Third Year	E		2		
	インターンシップ研修 B Internship Training B					1～10	
	都市・建築学博士特別講義 Special Lecture for Doctoral Course in Architecture and Building Science				2		
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						
専門科目 Major General Subjects	都市・建築学特別研修 Advanced Seminar in Architecture and Building Science			4			
	都市・建築学博士研修 Research for Doctor's Thesis in Architecture and Building Science			8			

1，上記科目の単位数を合わせて 16 単位以上を修得すること。

Students must acquire 16 or more credits from the subjects above.

2，各授業科目の開講年度等は授業時間割等で確認すること。

Be sure to check the fiscal years in which each class is offered with the time schedule of the classes, program syllabus, etc.

3，『使用言語』欄のアルファベット記号について

Language Key

J:日本語開講科目（Lectures in Japanese）

E:英語開講科目（Lectures in English）

JE:準英語開講科目（Lectures basically in Japanese, with English explanations）

Advanced Course on Architecture and Urban Design 2 credits
Elective Required
Professor Taro Igarashi
Professor Aya Kubota
Associate Professor Masashige Motoe
Associate Professor Takashi Fujino
Associate Professor Junichiro Higaya
Associate Professor Shunichi Nomura

This lecture addresses extremely modern and state-of-art subjects. In addition, available solutions, themes related to architecture and urban design, and future prospects will be provided in the lecture.

Advanced Course on Architecture and Urban Planning 2 credits
Elective Required
Professor Yasuaki Onoda
Professor Osamu Murao
Professor Michio Ubaura
Associate Professor Haruka Tsukuda

In this lecture, we will focus on urban-scale issues among the most advanced research topics in the field of the Architectural and Urban Planning, including current achievements, technical challenges, related disciplines to be developed, and future prospects.

Advanced Course on Sustainable Architecture and Building Science 2 credits
Elective Required
Professor Akashi Mochida
Professor Natsuko Nagasawa
Associate Professor Tomoya Nishiwaki
Associate Professor Tomonobu Goto
Associate Professor Hikaru Kobayashi

This lecture discusses the cutting-edge research topics in the Sustainable Architecture and Building Science Course, including current achievements and technical problems faced, related academic fields to be explored, and prospects.

Advanced Course on Structural Engineering for Architecture 2 credits
Elective Required
Professor Masaki Maeda
Professor Yoshihiro Kimura
Professor Kohju Ikago
Professor Takeshi Sato
Associate Professor Noriyuki Takahashi
Associate Professor Susumu Ohno
Associate Professor Akihiro Shibayama

In this lecture, the most advanced research topics of the Structural Engineering for Architecture Group, including the current state of progress, technical issues to be faced, related disciplines to be developed, and future prospects, are discussed.

CFD Modeling for Building Environment Design 2 credits
Elective Required
Professor Akashi Mochida

Turbulent diffusion strongly influences the wind environment in urban areas, wind loading on structures, the thermal environment and air quality in and around buildings. An introduction is given to CFD simulations of airflow—related phenomena in and around buildings using various turbulence models, namely standard and revised k-e models, ASM, DSM and LES. Canopy flow models for reproducing aerodynamic effects of flow obstacles whose sizes are smaller than computational grid cell is also introduced. Emphasis is placed on the performance of these models and the essentials of modelling techniques when they are applied to complex flow fields related to the built environment. Furthermore, the way how the turbulent flow simulations can be utilized for environmental design is also provided.

Internship Training B 1～10 credits
Elective
All faculty

For the purpose of cultivating a variety of practical abilities, students practice architectural design, structural design, equipment design and construction supervision at domestic, overseas companies and design offices. Through this seminar, students are expected to experience and understand how to proceed with practical work and group work on programing, planning, designing, construction, post-training etc. Trainees submit training plans and training reports to training institutions and academic advisors. One credit is accredited every 30 hours for training hours. Credits will be dealt with according to the training time. However, the upper limit is 10 credits.

Special Lecture for Doctoral Course in Architecture and Building Science 2 credits
Elective Required

This is a special lecture on the latest academic research in specialized fields and related fields, especially on the creation and development of academic fields.

Advanced Seminar in Architecture and Building Science 4 credits
Required
All faculty

Belonging to each group of architecture and urban design, architecture and urban planning, sustainable architecture and building science, and structural engineering for architecture, discussions are held based on domestic and foreign literature introductions, material collections, workshops, reports, etc. based on themes. Acquire advanced knowledge.

Research for Doctor's Thesis in Architecture and Building Science 8credits Required All faculty Belonging to each group of architecture and urban design, architecture and urban planning, sustainable architecture and building science, and structural engineering for architecture. Participate in experiments and exercises such as research presentations, discussions, and domestic and foreign literature introductions based on certain research results related to doctoral dissertations.	

授業科目表（DC）Opening of a course class subject list

Department of Management Science and Technology

区分 Category	授業科目 Subject	開講時期 Schedule	使用言語 Language	単位 Credit 必須 Required	単位 Credit 選択必須 Elective Required	単位 Credit 選択 Elective	備考 Remarks
学際基盤科目 Interdisciplinary Basic Subjects	技術戦略特論 Advanced Technology Strategy	隔年 Every Other Year	J		2		左記の学際基盤科目，特別講義Ｂのうちから，４単位以上を選 択履修すること。 At least 4 credits must be selected from the Interdisciplinary Basic Subjects and Advanced Topics B listed on the left.
	イノベーションとアントレプレナーシップの経済学入門 B Introduction to Economics of Innovation and Entrepreneurship B	毎年 Every Year	E		2		
	アントレプレナーシップの経済学 B Economics of Entrepreneurship B	毎年 Every Year	E		2		
	イノベーション政策 B Innovation Policy B	隔年 Every Other Year	E		2		
	特許戦略の経済学 B Economics of Patent Strategy B	隔年 Every Other Year	E		2		
	経営システム特論 Advanced Management Systems	毎年 Every Year	J		2		
	知的財産戦略 Intellectual Property Strategy	毎年 Every Year	J		1		
	プロジェクト・リーダーシップ Project Leadership	毎年 Every Year	J		2		
	価値システム Value Systems	毎年 Every Year	J		2		
	新事業創造論 New Business Creation	毎年 Every Year	J		2		
	リスク管理学特論 Advanced Theory and Practice of Risk Assessment	毎年 Every Year	J		2		
	価値創造工学論 Value Creation Engineering	隔年 Every Other Year	JE		2		
	技術適応計画特論 Advanced Management of Integrated System Technology	毎年 Every Year	J		2		
	カーボンニュートラル特論 Carbon Neutral Applications	毎年 Every Year	E		2		
	エネルギーデバイス工学特論 Advanced Energy Device Engineering	毎年 Every Year	J		2		
	情報感性工学特論 Advanced Information Affective Engineering	毎年 Every Year	J		2		
専門科目 Major General Subjects	技術社会システム特別講義B Advanced Topics in MS&T B				2		

	ソーシャルシステムデザイン特別研修Ｂ Group Studies in Social System Design B				2		左記の特別研修Ｂのうちから，２単位以上選択履修すること。 At least 2 credits must be selected from the Group Studies B listed on the left.
	バリュープロポジション特別研修Ｂ Group Studies in Value Proposition B				2		
	技術社会システム博士研修 Doctoral Thesis Research in Management Science and Technology			8			
関連科目 Related Subjects of Other Majors	本研究科委員会において関連科目として認められたもの。 Those approved by the Educational Committee of the Graduate School of Engineering						

1，上記科目の単位数を合わせて 16 単位以上を修得すること。
Students must acquire 16 or more credits from the subjects above.
2,『開講時期』については，現時点におけるものであり，変更になることもある。開講年度などは授業時間割などで確認すること。
“Class Schedule” is currently tentative and may be subject to change.
Make sure to check the fiscal years when each class is offered with the time schedule of the classes, program syllabus, etc.
3,「使用言語」欄のアルファベット記号について
Language Key
E:英語開講科目（Lectures given in English）
JE:準英語開講科目（Lectures basically given in Japanese, with English explanations）
J:日本語開講科目（Lectures given in Japanese）

技術戦略特論 2 credits

Advanced Technology Strategy
Elective Required
Professor Shuichi Ishida

企業経営においてイノベーションを検討するうえで必要な技術戦略の考え方について検討する。また情報技術やデバイス産業に焦点を合わせた事例の解説などを交え，総合的にイノベーション・マネジメントを基礎とした技術戦略の理論と事例に触れることを目的としている。
This session examines the concept of technological strategy, which is necessary for considering innovation in business management. Case studies focusing on various industries will also be presented. The aim is to provide a comprehensive introduction to the theory and case studies of innovation management-based technology strategy.

イノベーションとアントレプレナーシップの経済学入門B 2 credits

Introduction to Economics of Innovation and Entrepreneurship B
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about historical aspects of innovation and entrepreneurship. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

アントレプレナーシップの経済学B 2 credits

Economics of Entrepreneurship B
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about theoretical aspects of innovation and entrepreneurship. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

イノベーション政策B 2 credits

Innovation Policy B
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about theoretical framework for industrial innovation and a broad range of public policies to promote innovation. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

特許戦略の経済学B 2 credits

Economics of Patent Strategy B
Elective Required
Associate Professor Nobuya Fukugawa

Each class of this online course consists of my lecture (45 minutes) and students' presentations (45 minutes). Students need to have a good command of English. I talk about theoretical framework for economic incentives and consequences of patent strategies. Students must prepare for presentations based on papers assigned every week, which requires 90 study hours in total. Read online syllabus for assignments and presentation schedule. Realtime attendance at all classes is required as no recorded materials are provided. Students who consider joining this course must attend the first class held at Google Classroom using university email address. Access using other accounts will be denied.

経営システム特論 2 credits

Advanced Management Systems
Elective Required
Professor Akira Nagamatsu

本講義では，技術とイノベーションに係る企業のマネジメントにおいて主として技術革新により新製品を生み出す理論についてわが国及び欧米の最新の論文や研究成果等を取り扱う。特に，最近わが国を中心に提唱され世界的に注目されているアーキテクチャー理論や知識創造理論も中心としつつ，Fuzzy Front 理論，標準化戦略リードユーザー等のプロダクトイノベーションやプロセスイノベーションを生み出すための企業内における組織論についても触れる内容とし，イノベーションに関する理論と実務の融合を目指す講義とする。
This course aims to integrate theory and practice in innovation by explaining the latest papers and research results in the management of companies related to technology and innovation.

知的財産戦略 1 credits

Intellectual Property Strategy
Elective Required
Professor Shuichi Ishida

特許や実用新案などの産業財産権と著作権を総称して知的財産権(IPR）と呼び，工業分野では技術の一つの認識や表現の仕方として益々重要性が増している。それら知的財産権の基本的理解を深め，運用の仕方や戦略性を学ぶ。
Patent and utility model rights are protected as rights stipulated by law or rights on legally protected interests. The basic concept of intellectual property will be systematically studied with concrete examples. The lecture is given over a two-day intensive course, so paying attention to the separate lecture schedule is necessary.

プロジェクト・リーダーシップ 2 credits

Project Leadership
Elective Required
Professor Shuichi Ishida

本講義では，プロジェクトを構成する各活動の計画立案，日程表の作成，および進捗管理などが，計画（Plan），実行（Do），チェック（Check），是正（Action）という管理サイクル（PDCA サイクル）に基づいて稼動している必要性を解説する。また，リスク測定，利用できる資源の見積作業の系統化，WBS（Work Breakdown Structure）の作成，人的・物的資源の確保，費用の見積，チームメンバーへの作業の割り振り，進捗管理，目的に沿った結果が出るような作業の方向性維持，および達成した結果の分析・評価を講義する。
In this lecture, the management cycle (PDCA cycle) of Plan, Do, Check and Action is explained, which includes planning, scheduling and progress management of the activities that make up the project. The lecture is based on the concept of management strategy in the broader context.

価値システム 2 credits

Value Systems
Elective Required
Professor Akira Nagamatsu

イノベーション創出での重要課題である「魔の川」「死の谷」「ダーウィンの海」などのマネジメント上の問題や企業内部における研究部門，開発部門および事業部門との間の技術成果から製品を上市するまでの障害を有効に解決する手法や評価を講義する。また，ロードマッピング，イノベーション・ポートフォリオマネジメント，イノベーションのアイデア創出，シナリオプランニング，イノベーション・プロジェクトの経済的評価を講義する。併せて，イノベーション組織や風土の再構築についても，オープン・イノベーションの議論も踏まえて講義する。新興国におけるイノベーション・マネジメントについても講義する。
This course covers management issues in innovation creation and methods to solve obstacles from technological results to product launch. The restructuring of innovation organization and culture and innovation management in emerging countries will also be discussed.

新事業創造論 2 credits

New Business Creation
Elective Required
Professor Shuichi Ishida

主に技術的な取り組みを事業化するために必要となる基本的な考え方を学ぶ。まずグローバルな視点から世界のベンチャーの動向について知識を深めこの領域における土地勘を養う。さらにアクティブラーニング形式で事業アイディアをコンセプトにまとめ戦略に落とし込むまでの一連の過程をグループ討議などによって演習する。ベンチャーに関する緒論は一講義で完結的に網羅することは困難なので，本講義では内容を詰め込み過ぎず事業スタートアップの初期段階に絞って内容を進める。
This course covers business creation theory based on business administration from theoretical and case study perspectives. The domain extends not only to management strategy but also to entrepreneurship theory. The course is designed to be accessible to engineering graduate students who have never studied business administration.

リスク管理学特論 2 credits

Advanced Theory and Practice of Risk Assessment and Management
Elective Required
Professor Makoto Takahashi
Associate Professor Daisuke Karikawa

複雑・大規模な技術システム，社会システムを対象として，実践的なリスク評価と管理の方法論を講義する。特に人間と機械システムの相互作用組織的要因がもたらす共通モード的組織劣化に重点を置き，レジリエンスエンジニアリングの概念を基盤としてその明示化と管理方策に関して議論する。基本的方針として後知恵に基づく事後分析に偏りがちな後追い対策ではなく，プロアクティブなリスク認知と対策立案に関して述べる。更に，このようなプロアクティブなリスク認知において重要な役割を果たすリスクコミュニケーションや技術者倫理に関しても講述する。講義に際しては理論と現場応用の両面に配慮して，代表的な大規模システムを対象としたケーススタディーを重視する。
The aim of this lecture is to understand practical methodology of risk assessment and management for large-scale complex socio-technical systems. The activities of traditional safety risk management are mainly reactive, meaning they focus on correcting defects after negative events occurred. This lecture, on the other hand, discusses proactive risk management methodology with emphasis on human-machine interaction, organizational issues, and the concepts of resilience engineering. The topics of this lecture also cover risk communication and engineering ethics.

価値創造工学論 2 credits

Value Creation Engineering
Elective Required
Professor Hirokazu Moriya

本講義では，企業等の財務諸表を分析し，諸表上の数値や有価証券報告書情報，その他各種公開データから企業の価値創造戦略をひも解き，社会価値創造の本質や価値を捉える力をつける．また，実企業を対象として，財務諸表的な考え方に基づいて新事業の立案を行う．世界の動きを俯瞰する力，社会の変化を各種データに基づいて分析する力，事象の本質を把握する力，より良い社会にするためのコトづくりと新しい価値を生み出し社会に実装する力を，国内外機関の講師によるワークショップ等も交えながら養っていく．
We will analyze financial statements of companies to unravel the value creation strategies using numerical data, information on the statements, and various publicly available data. The aim is to develop the ability to grasp the essence and value of social value creation. Additionally, the course involves formulating new business plans for real companies based on financial perspectives. Through workshops led by instructors from domestic and international universities and companies, students will cultivate skills such as the ability to overview global trends, analyze societal changes using various data, comprehend the essence of events, and contribute to creating a better society by generating new values and implementing them in society.

技術適応計画特論 2 credits

Advanced Management of Integrated System Technology
Elective Required
Professor Makoto Takahashi

少子高齢化や経済格差などの国レベルの巨大な問題，天災やパンデミックなどの予測できない事象，持続可能性や多様性の包摂，Z 世代への社会的移行などの学際的な議題...VUCA と呼ばれる何もかもが不確実な 21 世紀に工学者はどう向き合い，先進技術をどのように適用すべきだろうか？
本講義はこの問いに対し，スペキュラティヴデザイン，トランジションデザインといった最新のデザイン手法を用いて，未来の社会像を想像・夢想により可視化し，そのビジョンから遡り先進技術の可能性や方向性を計画する，バックキャスティングの手法を演習型で学ぶ。事前知識・デザイン経験は不要。
Everything is uncertain in this century, called VUCA times. We face substantial complex issues, such as aging society, economic disparity, unpredictable natural disasters and pandemics, and more interdisciplinary matters like sustainability, diversity, and social transition to Generation Z. How should engineers tackle this ambiguity and apply advanced technology?
This lecture aims to answer this question by imagining and dreaming visions of the future society through the latest design methods, such as Speculative Design and Transition Design. Students will learn the backcasting techniques to think back about the applicability of the technology from the future. No prior knowledge or design experience is required.

カーボンニュートラル特論 2 credits

Carbon Neutral Applications
Elective Required
Professor Toshihiko Nakata

気候変動の解決方策としてのカーボンニュートラルの基本と応用を，現状のエネルギーシステム分析，シナリオモデリング，再生可能エネルギーの技術イノベーションの観点から習得する。
The class focuses on the application of carbon neutrality as a solution to climate change from the perspectives of current energy system analysis, scenario modeling, and renewables technological innovation.

エネルギーデバイス工学特論　2 credits

Advanced Energy Device Engineering

Elective Required
Professor Kenji Nakamura

電気工学および関連分野の中でもエネルギーデバイスの応用について，広範で，かつ深い専門知識を講義すると共に，現時点における問題点の発掘とそれに対応する新しい問題解決方法を考究し，博士課程学生の問題発見・設定能力の涵養に主眼をおく。
This course provides a broad and deep expertise in the application of energy devices in electrical engineering and related fields, and focuses on cultivating the problem-finding and problem-solving abilities of doctoral students by identifying current problems and developing new problem-solving methods to address them.

情報感性工学特論　2 credits
Advanced Information Affective Engineering
Elective Required
Professor Takahiro Ishinabe

情報ディスプレイ技術は、人と情報とを繋ぐ私たちの社会に不可欠な光技術です。本講義では、各種の情報ディスプレイ技術の歴史、基本構成と動作原理、応用例や今後の展開について、また関連する部材技術について解説する。また、人が光をどのように感じ、情報として受け取るのかという人の認識や理解、感性と情報との関わりについても学ぶ。

Information display technology is an optical technology essential to our society that connects people to information. The aim of this course is to understand the history, basic structure, principle of operation, application examples, future development of information display technology including related materials. A human perception of light and a relationship between information and human cognition, understanding, and sensitivity will also be discussed.

技術社会システム特別講義B　2 credits

Advanced Topics in MS&T B

Elective Required
All Faculty

専門分野に係わる学問の創造と発展に関する特別講義であり，個別の対象にケース･メソッド(事例研究）を導入して実務能力と応用力を涵養する。
This course provides special lectures on the specific domain concerning creation and development of science . The case method is introduced to help students acquire practical skills.

ソーシャルシステムデザイン特別研修B　2 credits

Group Studies in Social System Design B

Elective Required
All Faculty Members belonging to the Course

ソーシャルシステムデザイン分野の学術研究および社会動向の変化を理解し，博士研究を進める上で基本となる研究の価値と社会実装手法を研鑽する。
In this course, students will understand the changes in academic research and social trends in the field of social system design, and study the value of research and social implementation methods that are fundamental to conducting doctor's research.

バリュープロポジション特別研修B　2 credits

Group Studies in Value Proposition B

Elective Required
All Faculty Members belonging to the Course

バリュープロポジション分野の学術研究および社会動向の変化を理解し，博士研究を進める上で基本となる研究の価値と社会実装手法を研鑽する。
In this course, students will understand the changes in academic research and social trends in the field of value proposition, and study the value of research and social implementation methods that are fundamental to conducting doctor's research.

技術社会システム博士研修　2 credits

Doctoral Thesis Research in Management Science and Technology

Required
All Faculty

バリュープロポジション，ソーシャルシステムデザインの各グループにおいて，研究発表，討論などを含む実験及び演習に参加する。
These seminars are reserved for students receiving guided research from supervisors. Students engage in experiments and seminars, as well as research presentations, discussions, and literature reviews.

Department of Mechanical Systems Engineering

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Related to Mechanical

Major Basic Subjects
- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Major General Subjects
- Oxidation in HighTemperature Environments of Structures and Materials
- Design of Natural Energy
- Mechanical Systems Maintenance Engineering

Related to Design and Manufacturing

Major General Subjects
- Nano/Micro Tribology
- Ultraprecision Machining
- Micro-Nanomechanical Architectonics
- Manufacturing Systems

Related to Fluid Mechanics

Major Basic Subjects
- Fluid Dynamics
- Applied Fluid Mechanics

Major General Subjects
- Functional Fluids Engineering

Related to Systems and Design

Major Basic Subjects
- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Major General Subjects
- Intelligent Machine Design

Related to Thermal and Energy

Major Basic Subjects
- Thermal Sience and Engineering A
- Thermal Sience and Engineering B

Major General Subjects
- Energy Systems Engineering

Mathematics and Science

Major Basic Subjects
- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics

Others

Major Basic Subjects
- Structure and Function of Living System

Doctoral Degree Program

Common Subjects for Mechanical and Intelligent Systems

Interdisciplinary Basic Subjects
- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Mechanical Systems Engineering

Master Degree's Program – Major General Subjects
- Introduction to Solid Ionics
- Neuromorphic Device Engineering
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Special Lecture on Mechanical Systems Engineering A

Doctoral Degree Program – Interdisciplinary Basic Subjects
- Advanced Intelligent Design
- Advanced Energy Systems Engineering
- Fracture Mechanics and Mechanism
- Intelligent Fluid Systems
- Advanced Mechanical Systems Maintenance Engineering
- Multidisciplinary Research and Application of Solid-State Ionic
- Advanced Nano/Technology
- Advanced Bio-Nanotechnology

Doctoral Degree Program – Major General Subjects
- Special Lecture on Mechanical Systems Engineering B

Internship / Seminar

Master Degree's Program – Major General Subjects
- Advanced Seminar on Mechanical Systems Engineering A
- Internship Training
- International Scientific Internship Training
- Seminar on Mechanical Systems
- Seminar on Energy Systems Engineering
- Seminar on Intelligent Mechano-Systems
- Master's Thesis Research in Mechanical Systems and Engineering

Doctoral Degree Program – Major General Subjects
- Advanced seminar on Mechanical Systems Engineering B
- Doctoral Thesis Research in Mechanical Systems and Engineering

Department of Finemechanics

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to Mechanical Materials

- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Related to Fluid Mechanics

- Fluid Dynamics
- Applied Fluid Mechanics

Related to Control and Engineering

- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Related to Finemechanics

- Thermal Sience and Engineering A
- Thermal Sience and Engineering B
- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics
- Structure and Function Living System

Major General Subjects

Related to Mechanical Materials

- Sensing and Evaluation of Materials System
- Design of Materials System

Related to Design and Manufacturing

- Nano/Micro Tribolody
- Ultraprecision Machining
- Manufacturing Systems
- Nano/Micro Mechanoptics

Related to Fluid Mechanics

- Biofluid Mechanics

Related to Finemechanics

- Optical Metrology
- Green Nanotechnology
- Geo-technical and Energy Engineering
- Biosensor Engineering
- Bio-Micromachine Engineering
- Special Lecture Series on Integrated Biomechanics Ⅰ
- Intelligent Mechanosystem Analysis
- Nano-and Micro-Surface Metrology and Engineering
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Special Lecture on Finemechanics A

Internship / Seminar

- Advanced Seminar on Finemechanics A
- Internship Training
- International Scientific Internship Training
- Seminar on Materials and Mechanics
- Seminar on Nanomechanics
- Seminar on Biomechanics
- Seminar on Intelligent Mechano-Systems
- Master's Thesis Research in Finemechanics

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common Subjects for Mechanical and Intelligent Systems

- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Finemechanics

- Advanced Mechanics of Materials
- Advanced Nano/Technology
- Nano-Flow Science
- Advanced Soft Mechanics
- Fracture Mechanics and Mechanisms
- Advanced Bio-Nanotechnology
- Special Lecture Series on Integrated Biomechanics Ⅱ
- Intelligent Mechanosystem Engineering
- Advanced Nano-and Micro-Surface Metrology and Engineering

Major General Subjects

Related to Finemechanics

- Special Lecture on Finemechanics B

Internship / Seminar

- Advanced Seminar on Finemechanics B
- Doctoral Thesis Research in Finemechanics

Department of Robotics

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to Mechanical
- Solid Mechanics
- Mechanics of Plasticity
- Materials Chemistry
- Solid State Physics
- Continuum Mechanics
- Structural Mechanics

Related to Fluid Mechanics
- Fluid Dynamics
- Applied Fluid Mechanics

Related to Control and Engineering
- Syetem Control Engineering Ⅰ
- Syetem Control Engineering Ⅱ
- Computer Hardware Fundamentals
- Robot Vision
- Digital Signal Processing

Related to Thermal and Energy
- Thermal Sience and Engineering A
- Thermal Sience and Engineering B

Mathematics and Science
- Numerical Analysis
- Statistical modeling
- Introduction to Classical Mechanics and Physical Mathmatics

Others
- Structure and Function of Living System

Major General Subjects

Related to Design and Manifacturing
- Micro Electro Mechanical Systems
- Nano/Micro Mechanoptics

Related to Fluid Mechanics
- Fluid Design Informatics
- Functional Fluids Engineering

Related to Control and Engineering
- Advanced Robotics
- Biomechatronics
- Human-Robot Informatics
- Tough Cyberphysical AI

Related to Robotics
- Foundations of Molecular Robotics
- Intelligent Mechanosystem Analysis
- Neuro Robotics
- Introduction to Solid State Ionics
- Intelligent Control Systems
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Special Lecture on Robotics A

Internship / Seminar
- Internship Training
- International Scientific Internship Training
- Special lecture on Robotics A
- Seminar on Nano-Systems
- Seminar on Robot-Systems
- Master's Thesis Research in Robotics

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common Subjects for Mechanical and Intelligent Systems
- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Robotics
- Advanced Bio-Nanotechnology
- Special Lecture Series on Integrated Biomechanics Ⅱ
- Adcanced Robotics
- Intelligent Mechanosystem Engineering
- Advanced Intelligent Design
- Advanced Nano/Technology

Major General Subjects

Related to Robotics
- Special Lecture on Robotics B

Internship / Seminar
- Advanced Seminar on Robotics B
- Doctoral Thesis Research in Robotics

Department of Aerospace Engineering

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects	Major General Subjects
Related to mechanical	**General Subjects**
Solid Mechanics	Environmental Administration
Mechanics of Plasticity	Ethics of Engineering and Life
Materials Chemistry	
Solid State Physics	
Continuum Mechanics	
Structural Mechanics	
Related to Fluid Mechanics	
Fluid Dynamics	Computational Fluid Dynamics
Applied Fluid Mechanics	Applied Mathematical Fluid Dynamics
	Fluid Design Informatics
Related to Control and Engineering	
Syetem Control Engineering Ⅰ	Mathematical Modeling and Computaion
Syetem Control Engineering Ⅱ	High Performance Computing
Computer Hardware Fundamentals	Computer Architecture
Robot Vision	
Digital Signal Processing	
Related to Thermal and Energy	**Related to Aerospace**
Thermal Sience and Engineering A	Aerospace Systems
Thermal Sience and Engineering B	Aerospace Propulsion
	Robotics for Space Exploration
	Spacecraft Engineering
	Special Lecture in Cooperation with JAXA
	Special Lecture on Aerospace Engineering A
Mathematics and Science	
Numerical Analysis	Physical Fluctuomatics
Statistical modeling	
Introduction to Classical Mechanics and Physical Mathmatics	
Other	
Structure and Function of Living System	
Internship / Seminar	
	Internship Training
	International Scientific Internship Training
	Advanced Seminar on Aerospace Engineering A
	Seminar on Aero Systems
	Seminar on Space Systems
	Master's Thesis Research in Aeronautics and Space Engineering

Doctoral Degree Program

Interdisciplinary Basic Subjects	Major General Subjects
Common subjects for Mechanics and Intelligent Systems	
History of Modern Technology	
New Business Creation	
Venture Strategy	
Nano Magnetism and Magnetic Engineering	
Related to Aerospace	
Advanced Aero Systems Ⅰ	
Advanced Aero Systems Ⅱ	
Advanced Space Systems Ⅰ	
Advanced Space Systems Ⅱ	
Advanced Space Fluid Dynamics	
	Special Lecture onAerospace Engineering B
Internship / Seminar	
	Advanced Seminar onAerospace Engineering B
	Doctoral Thesis Research in Aeronautics and Space Engineering

Department of Quantum Science and Energy Engineering

Undergraduate Course

(Department of Mechanical and Aerospace Engineering)

- Mechanical Systems Course
- Finemechanics Course
- Robotics Course
- Aerospace Engineering Course
- Mechanical / Biomedical Engineering Course
- International Mechanical and Aerospace Engineering Course
- Quantum Science and Energy Engineering Course
- Environment and Energy Engineering Course

Master Degree's Program

Major Basic Subjects

Related to Mechanical

- Solid State Physics
- Materials Chemistry

Related to Quantum Science and Engineering

- Nuclear Reactor Engineering
- Safety Engineering of Nuclear Energy Systems
- Science and Engineering of Particle Beam
- Plasma Physics and Fusion Energy

Major General Subjects

Related to Mechanical

- Materials for Nuclear Energy Systems

Related to Quantum Science and Engineering

- Quantum and Statistical Mechanics
- Environmental Perspective on the Energy Flow
- Engineering for Neutron Devices
- Basics for Plant Life Management
- Experimental Nuclear System Engineering
- Advanced Practical Nuclear Engineering
- Concrete for Nuclear Power Plants
- General Earthquake Engineering
- Nuclear Safety Theory and Regulation Ⅰ
- Nuclear Safety Theory and Regulation Ⅱ
- Engineering for Nuclear Reactor Decommissioning
- Physical Fluctuomatics
- Environmental Administration
- Ethics of Engineering and Life
- Reinforced Concrete Structures
- Special Lecture on Quantum Energy Engineering A

Internship/Seminar

- Internship Training
- International Scientific Internship Training
- Advanced Seminar on Quantum Energy Engineering A
- Seminar on Advanced Nuclear Energy Engineering
- Seminar on Safety Engineering of Nuclear Energy Systems
- Seminar on Energy Physics Engineering
- Seminar on Particle-Beam Engineering
- Seminar on Energy Materials
- Seminar on Energy Chemical Engineering
- Seminar on Quantum Theoretic Materials Engineering
- Seminar on Accelerator Radiation Science and Engineering
- Master's Thesis Research in Quantum Science and Energy Engineering

Doctoral Degree Program

Interdisciplinary Basic Subjects

Common Subjects

- History of Modern Technology
- New Business Creation
- Venture Strategy
- Nano Magnetism and Magnetic Engineering

Related to Quantum Science and Engineering

- Advanced Theory and Practice of Risk Assessment and Management
- Advanced Safety Engineering of Nuclear Systems
- Advanced Fusion Reactor Engineering
- Advanced Health Physics Engineering
- Nanoscale Analysis of Nuclear Materials
- Engineering for Actinide Materials
- Advanced Nuclear Chemical Engineering
- Advanced Energy Physics Engineering
- Advanced Particle Beam Engineering
- Advanced Energy Material Engineering
- Advanced Accelerator and Radiation Engineering
- Advanced Quantum Science and Energy Engineering

Major General Subjects

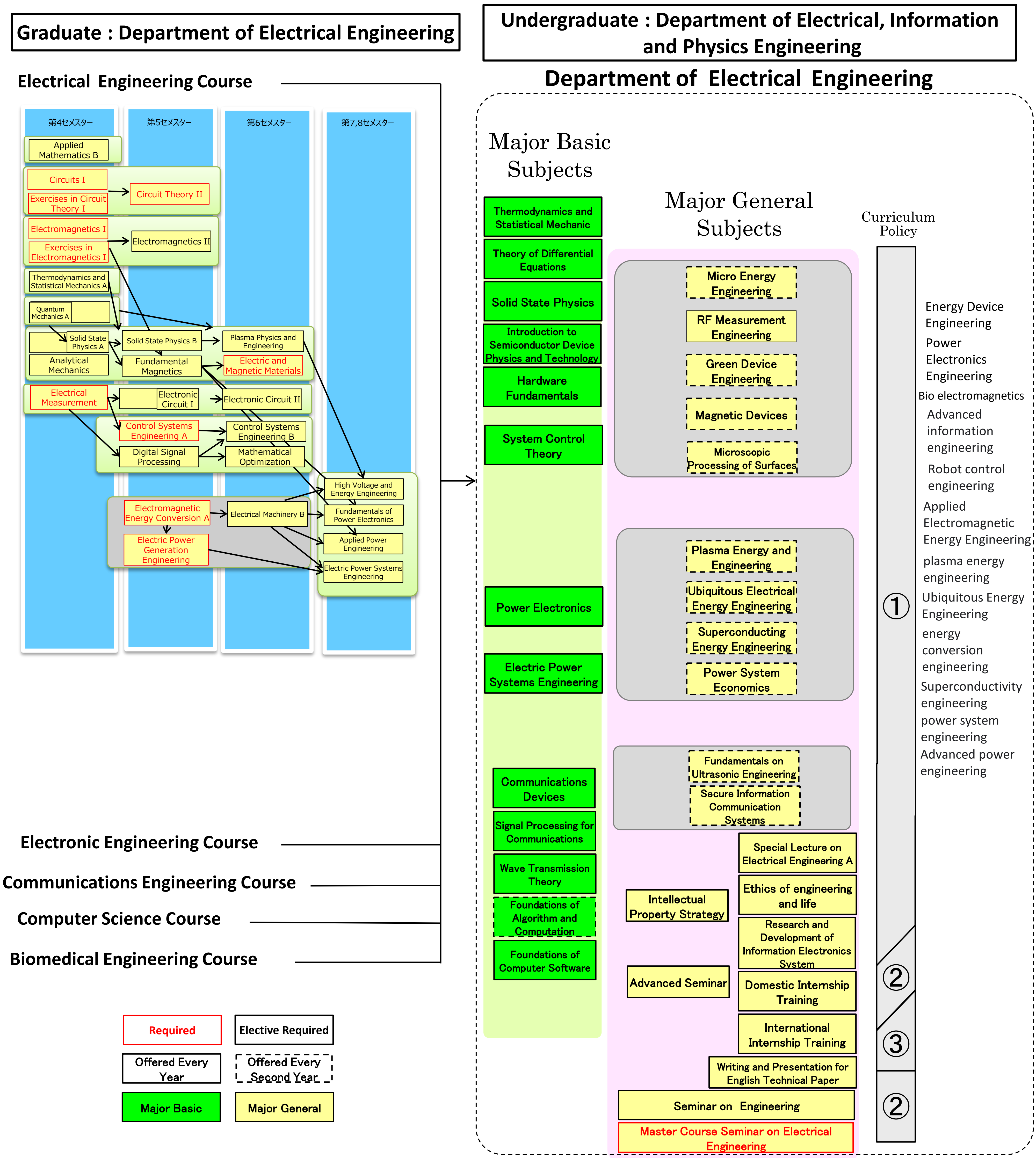
Related to Quantum Science and Engineering

- Special Lecture on Quantum Energy Engineering B

Internship/Seminar

- Special Seminar on Engineering
- Special Seminar on Quantum Energy Engineering B
- Doctoral Thesis Research in Quantum Science and Energy Engineering

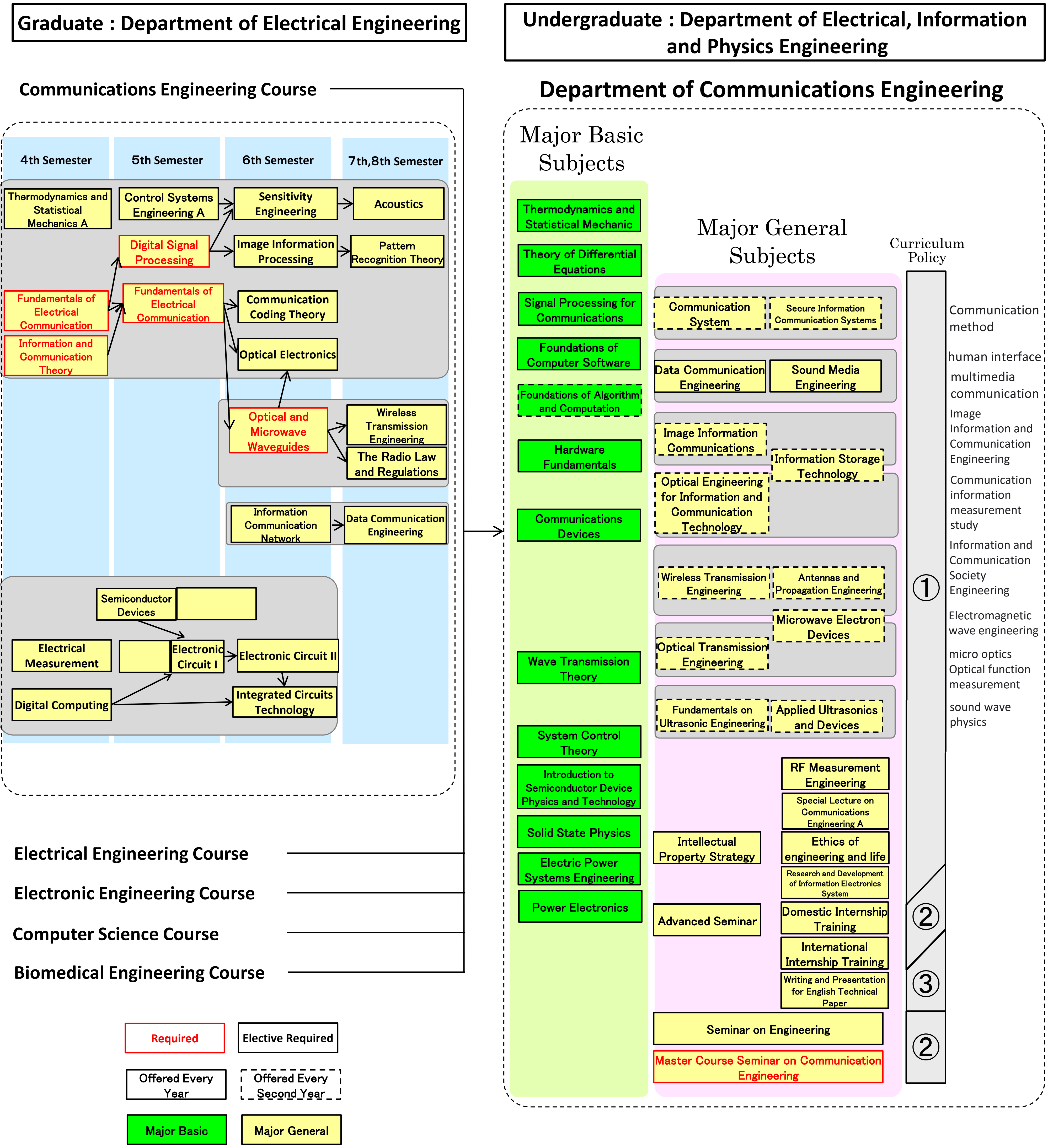
Curriculum Map : Department of Electrical Engineering



Curriculum Policy

1. Help students acquire the broad range of knowledge, advanced technical expertise, and interdisciplinary knowledge relating to their fields of expertise that are necessary to understand the essence of their research subjects and perform their research.
2. Enable students to acquire advanced skills to work on their research subjects and develop these subjects with unique ideas.
3. Provide students with the language proficiency necessary to perform their research and make presentations of the research results.

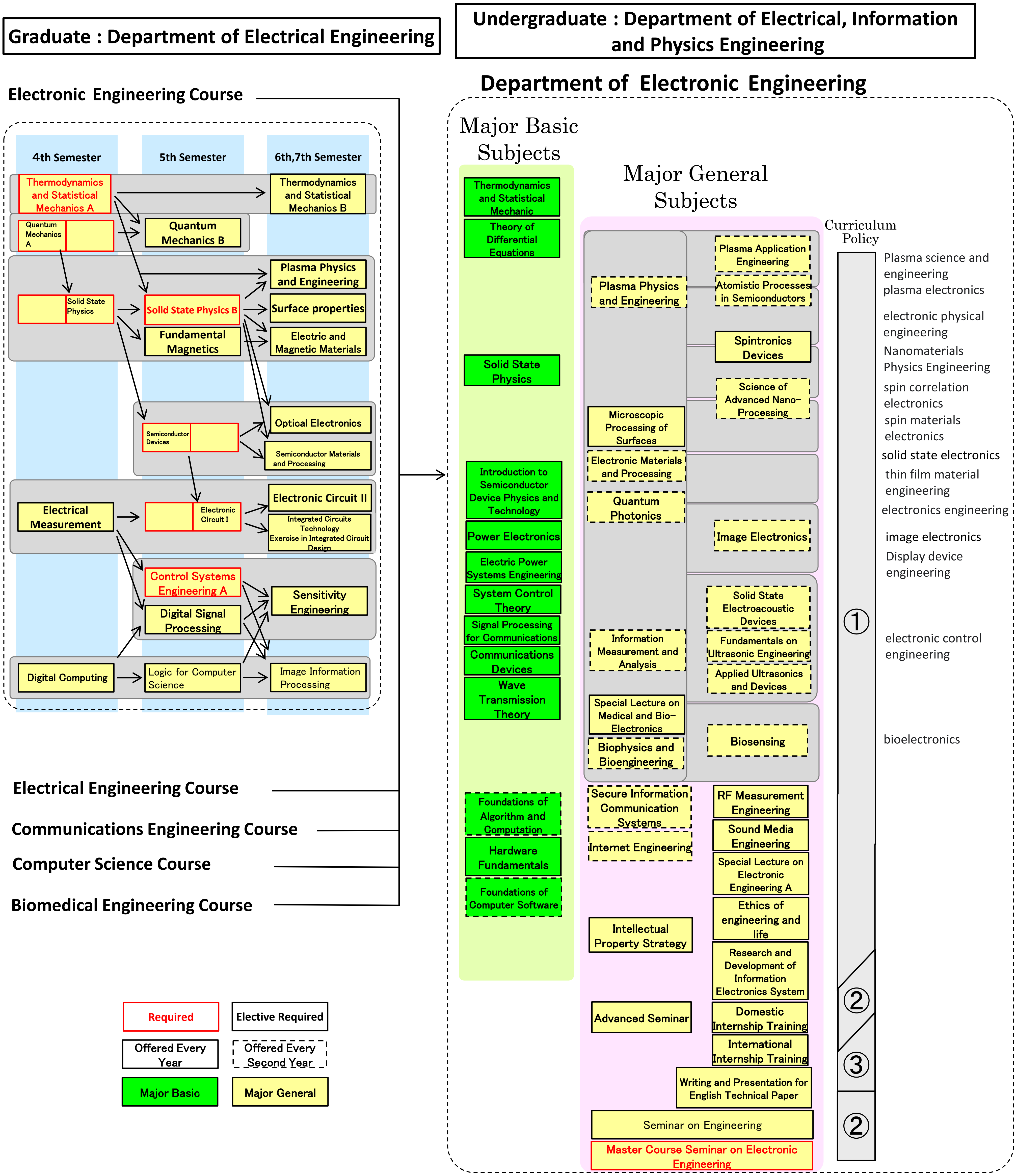
Curriculum Map : Department of Communications Engineering



Curriculum Policy

1. Help students acquire the broad range of knowledge, advanced technical expertise, and interdisciplinary knowledge relating to their fields of expertise that are necessary to understand the essence of their research subjects and perform their research.
2. Enable students to acquire advanced skills to work on their research subjects and develop these subjects with unique ideas.
3. Provide students with the language proficiency necessary to perform their research and make presentations of the research results.

Curriculum Map : Department of Electronic Engineering

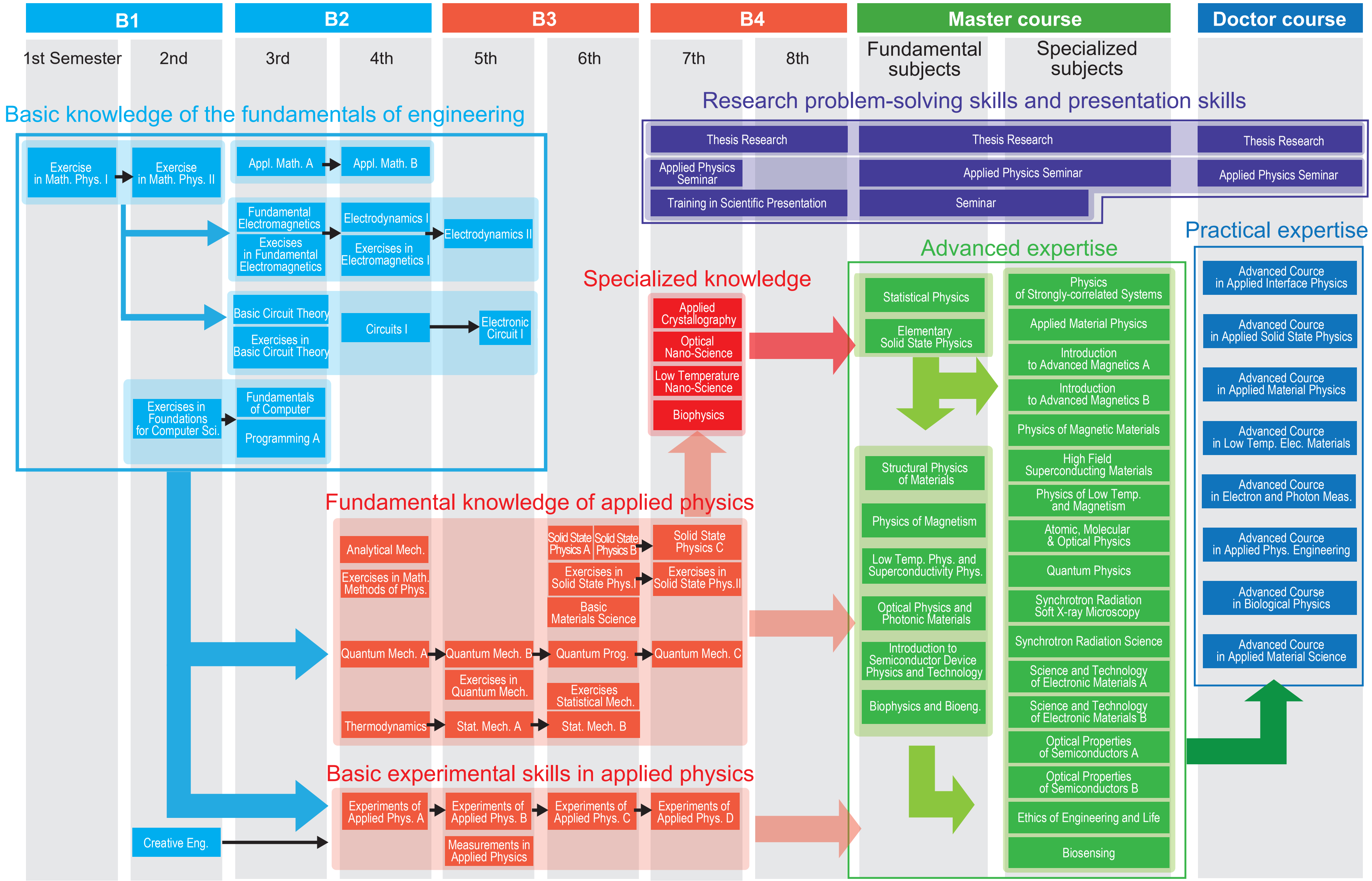


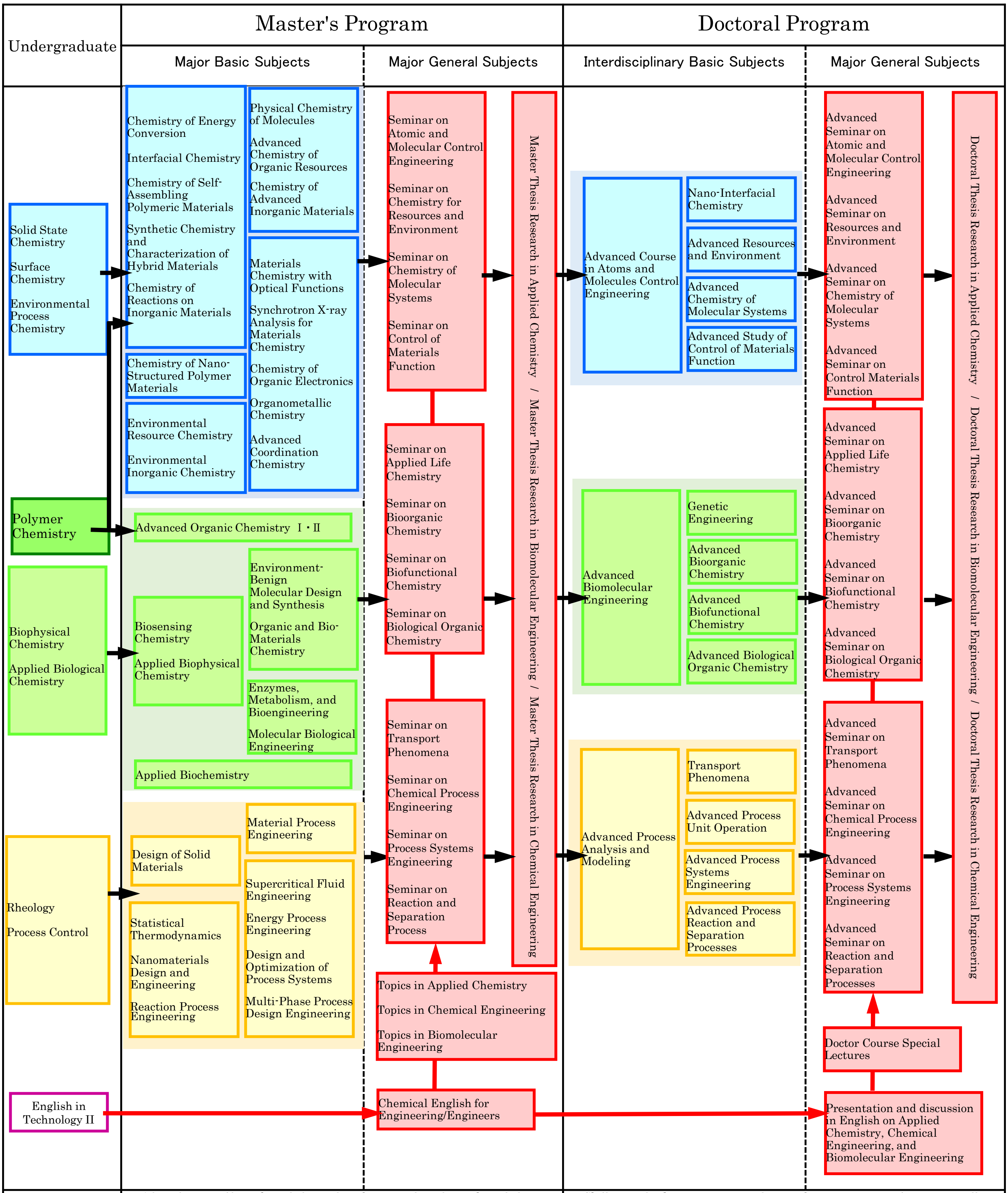
Curriculum Policy

1. Help students acquire the broad range of knowledge, advanced technical expertise, and interdisciplinary knowledge relating to their fields of expertise that are necessary to understand the essence of their research subjects and perform their research.
2. Enable students to acquire advanced skills to work on their research subjects and develop these subjects with unique ideas.
3. Provide students with the language proficiency necessary to perform their research and make presentations of the research results.

Department of Applied Physics

Curriculum Goals: The curriculum aims to provide students with the following skills and expertise in applied physics. (i) basic and advanced knowledge of applied physics and experimental techniques, (ii) ability to choose a research problem, propose a solution and perform it using acquired knowledge and techniques, and (iii) skills for presenting research results.





Diploma Policy

Master's Program

1. A broad range of basic knowledge and academic skills that help students understand and explore the essence of their research subjects;
2. Profound knowledge about their fields of expertise;

3. Interdisciplinary knowledge relating to their fields of expertise;
5. Skills to determine a research subject and solve issues;
7. Language proficiency to perform their researches; and
8. Basic skills to provide research or technical guidance.

4. System design skills obtained through the integration of knowledge outside their fields of expertise;
6. Advanced skills to perform, apply, and develop their researches;

Doctoral Program

1. Skills to embark on a new research subject and perform a research from a panoramic perspective that takes social needs into account;

4. Language proficiency as well as research paper writing, debating and communication skills that are sufficient to make presentations at international academic conferences, etc.;
5. Skills to provide research guidance; and
6. Basic skills to manage a research or project.

2. Skills to solve issues with unique ideas;
3. Thinking skills that allow for interdisciplinary application;

Undergraduate Course

Inorganic and Physical Chemistry, Chemical Engineering, organic chemistry, biochemistry

Master's Program／Doctoral Program

Applied Chemistry, Chemical Engineering, Biomolecular Engineering, Major General Subjects

Department of Metallurgy, Materials Science and Materials Processing Curriculum Map

Diploma Policy【Master's Program】

1. A broad range of basic knowledge and academic skills that help students understand and explore the essence of their research subjects;
2. Profound knowledge about their fields of expertise;
3. Interdisciplinary knowledge relating to their fields of expertise;
4. System design skills obtained through the integration of knowledge outside their fields of expertise;
5. Skills to determine a research subject and solve issues;
6. Advanced skills to perform, apply, and develop their researches;
7. Language proficiency to perform their researches; and
8. Basic skills to provide research or technical guidance.

Diploma Policy【Doctoral Program】

1. Skills to embark on a new research subject and perform a research from a panoramic perspective that takes social needs into account;
2. Skills to solve issues with unique ideas;
3. Thinking skills that allow for interdisciplinary application;
4. Language proficiency as well as research paper writing, debating and communication skills that are sufficient to make presentations at international academic conferences, etc.;
5. Skills to provide research guidance; and
6. Basic skills to manage a research or project.

graduation

graduation

Bachelor's Program

Course of Metallurgy

Course of Materials Science

Course of Materials Processing

Course of Environmental Studies

Master's Program M1～M2

Thermodynamics of Smelting & Refining
Reaction Kinetics in Metallurgical Processes
Theory of Phase Transformations
Iron and Steelmaking Process
Noufirrous Extractive Metallurgy
Advanced Casting Technology
Advanced Plastic Forming
Numerical Methods for Materials Processing
Advanced Steel Engineering
Non-ferrous Metallurgical and Environmental Science and Engineering

Materials Electrochemistry
Quantum Chemistry
Physics of Electrons in Solids
Crystal Physics and Engineering
Lattice Defects Theory
Computational Materials Science
Science of Surfaces and Interfaces in Materials
Magnetic Device Materials
Materials Science of Electronic and Optoelectronic Devices
Advanced Structual Materials
Nonequilibrium Materials
Energy Conversion and Functional Materials
Advanced Corrosion Engineering
Structural Characterization of Materials
Advanced Materials Characterization
Nanostructures and Function Control in Materials

Fatigue Strength and Fracture of Materials
Materials Theory
Evaluation of Materials
Mechanics of Elasticity and Plasticity
Applied Powder Processing and Powder Metallurgy
Advanced Welding and Joining Engineering
Biomaterials Science
Soft Materials
Functional Optical Materials

Internship training
Special Lectures on Material Science and Engineering
Special Seminar on Material Science and Engineering
Seminars in various fields of Metallurgy
Seminars in various fields of Materials Science
Seminars in various fields of Materials Processing

Research for Master's Thesis

Research for Master's Thesis in Metallurgy

Research for Master's Thesis in Materials Science

Research for Master's Thesis in Materials Processing

Doctoral Program D1～D3

Advanced Social Engineering for Material Engineers
Ecomaterials Science

Metallurgical Process Engineering & Advanced Seminar
Materials Forming and Stuructural Control & Advanced Seminar
Advanced Materials Physical Chemistry Control & Advanced Seminar
Advanced Course on Material Processing & Advanced Seminar
Control of Materials Processes & Advanced Seminar
Advanced Course on Materials Physical Chemistry

Advanced Materials Electrochemistry & Advanced Seminar
Advanced Topics on Nanoscale Materials Physics & Advanced Seminar
Materials and Devices for Information Technology & Advanced Seminar
Advanced Studies on Nano-Structured Materials & Advanced Seminar
Topics on Material Function and Synthesis & Advanced Seminar

Advanced Materials Processing
Interface Science and Engineering of Joining & Advanced Seminar
Advanced Microsystems Design and Processing & Advanced Seminar
Advanced Course on Physical Metallurgy and Physicoche-mistry of Biomolecular and Biomaterial Systems & Advanced Seminar
Advanced Structural Characterization of Materials & Advanced Seminar
Processing for Materials Function Control & Advanced Seminar

Internship training
Special Lecture on Metallurgy
Special Lecture on Materials Science
Special Lecture on Materials Processing

Research for Doctoral Thesis

Research for Doctoral Thesis in Metallurgy

Research for Doctoral Thesis in Materials Science

Research for Doctoral Thesis in Materials Processing

		Learning Goals	Basic research skills	Profound knowledge	Interdisciplinary knowledg	Knowledge integration	Problem setting and	practical application skills	Language ability	Basic leadership skills
		Diploma policy ability number	1	2	3	4	5	6	7	8
(First semester)										
Civil Engineering	Major Basic Subjects	Numerical Analysis	○		○					
		Spectral Analysis	○		○					
		Computational Solid Mechanics	○		○					
		Continuum Mechanics	○		○					
		Construction Materials	○		○					
		Geotechnical Engineering	○		○					
		Thin-Walled Structures	○		○					
		Structural Design	○		○					
		Environmental Microbial	○		○					
		Water Environment Engineering	○		○					
		Ecological Engineering	○		○					
		Data Science for Urban Transportation System	○		○					
		Project Evaluation	○		○					
		Transportation Systems Analysis	○		○					
		Micro Socio-Economic System	○		○					
		Special Lectures on Civil and Environmental Engineering	○						○	
	Major General Subjects	Nonlinear structural analysis		○		○				
		Mechanics of Inhomogeneous Materials		○		○				
		Maintenance Engineering		○		○				
		Computational Soil Mechanics		○		○				
		Computational Plasticity		○		○				
		Design of Earthquake Resistant Structures		○		○				
		Numerical Modeling of Water Waves and Currents		○		○				
		Hydrology		○		○			○	
		Disaster Reduction System		○		○				
		Environmental Reaction Engineering		○		○				
		Water Purification Engineering		○		○				
		Ecological Impact Assessment		○		○				
		Mathematics for Applied Economics		○		○				
		Quantitative Behavior Analysis		○		○				
		Mathematical Modeling & Analysis of Urban Systems		○		○				
		Urban Landscape Design		○		○				
		Analysis of Social Institution		○		○				
		Game Theory for Applied		○		○				
		Spatial Economics		○		○				
		Spatial Information Analysis		○		○				
		Project Risk Management I				○			○	
		Internship training				○	○	○		
		Seminar on Mathematical System Design					○	○	○	○
		Seminar on Infrastructural Materials					○	○	○	○
		Seminar on Civil Engineering					○	○	○	○
		Seminar on Hydraulics and Environmental Engineering					○	○	○	○
		Seminar on Regional System Engineering					○	○	○	○
		Master's Thesis Research in Civil					○	○	○	○

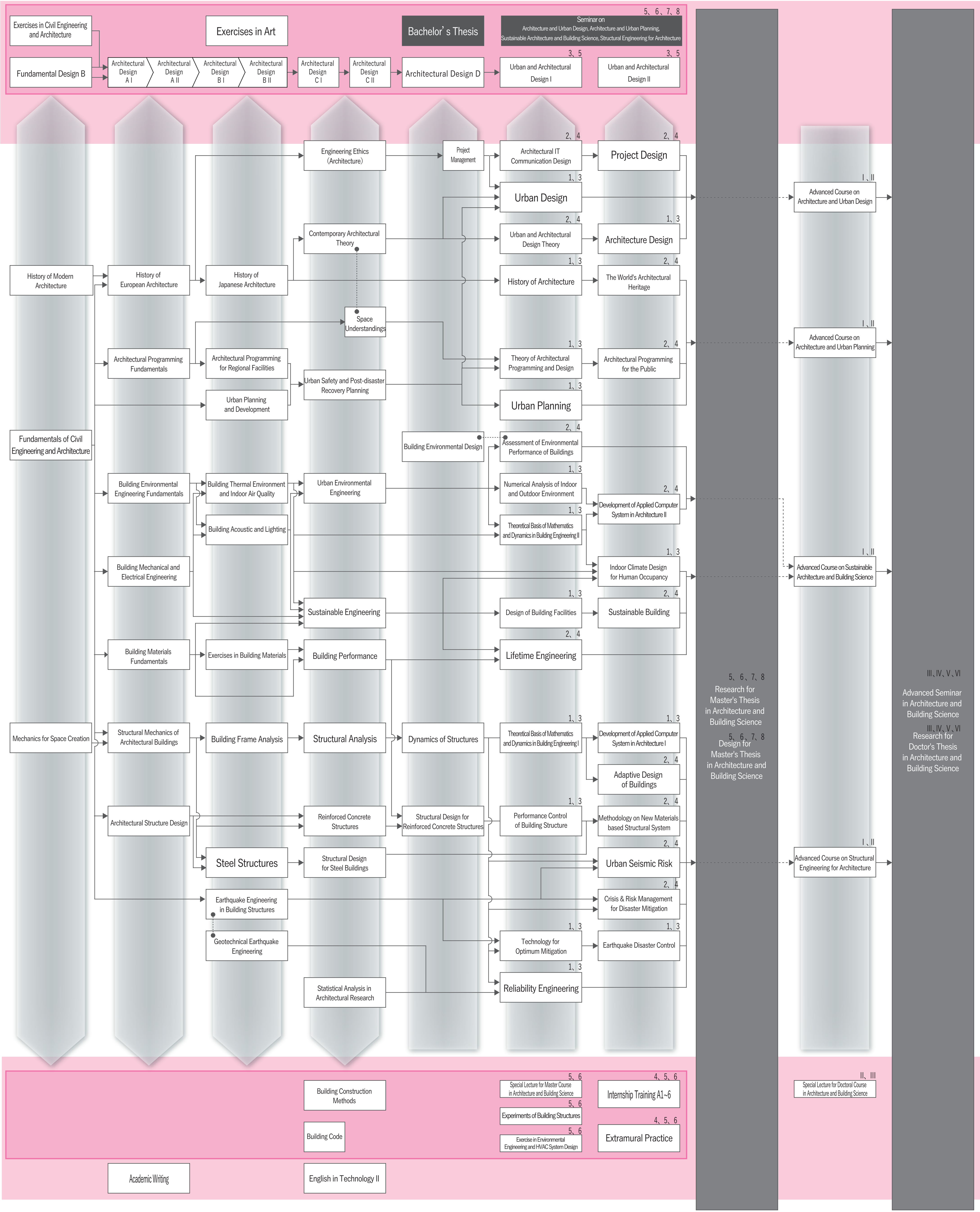
< Capabilities to be acquired >
Basic academic and language skills necessary to carry out research; Ability to develop a research theme based on original ideas and present it as a research paper; Research skills in specialized areas; Basic competencies for research and technical leadership; Advanced technical skills

		Learning Goals	Research and practical skills	Problem-solving ability	Applied skill	International communication skills	Leadership ability	Management ability
		Diploma policy ability number	1	2	3	4	5	6
(Second semester)								
Civil Engineering	Interdisciplinary Basic Subjects	Advanced Mathematical System Design	○	○				
		Advanced Infrastructural Materials	○	○				
		Advanced Civil Engineering Structures	○	○				
		Advanced Environmental Hydraulics and Water Quality Engineering	○	○				
		Advanced Regional System Engineering	○	○				
		Disaster Control Engineering	○	○				
		Special Lecture on Civil and Environmental Engineering				○		
	Major General Subjects	Advanced Seminar on Mathematical System Design			○	○	○	○
		Advanced Seminar on Infrastructural Materials			○	○	○	○
		Advanced Seminar on Civil Engineering Structures			○	○	○	○
		Advanced Seminar on Hydraulics and Environmental Engineering			○	○	○	○
		Advanced Seminar on Regional System Engineering			○	○	○	○
		Doctoral Thesis Research in Civil and Environmental Engineering			○	○	○	○

< Capabilities to be acquired >
Ability to develop research themes from a bird's eye view, taking into account social and international demands; Ability to develop the issue with original ideas; Ability to compile papers of international standard and present and discuss them at international conferences; Ability to carry out research proactively in related areas of expertise; Ability to continuously develop oneself and thrive globally as a leader

Department of Architecture and Building Science

3rd semester	4th semester	5th semester	6th semester	7th-8th semester	Master's Course 1st semester	Master's Course 2nd semester	Master's Course 3rd-4th semester	Doctoral Course
Introduction to Architecture	Basic Knowledge to Architecture		Current Information on Architectural Studies, Introduction to Expertise	Knowledge Integration, Problem Finding and Solving Skills, Presentation and Discussion Skills	Basic engineering theory for research and development, practical skills in specialized areas, ability to plan and conduct research, internationality, ability to disseminate information. Academic Goals (Relevant items are noted on the right shoulder of the subject) 1: Basic research knowledge and academic skills, 2: In-depth knowledge, 3 : Interdisciplinary knowledge. 4 : Knowledge integration and system design skills, 5 : Problem finding and solving skills, 6: Practical and applied development skills, 7 : Language skills, 8 : Basic teaching skills			Academic Goals (Relevant items are noted on the right shoulder of the subject) I: Research practice ability, II :Problem solving ability, III :Applied Skills, IV :International Communication Ability, V :Teaching Ability, VI :Management Ability



Management Science and Technology　Master's Programs　Curriculum Map

- Theoretical foundational knowledge of economics
- Practical Knowledge of Intellectual Property
- Knowledge of innovation and intellectual property rights
- Practical knowledge of social systems
- Cultivate a broad perspective and problem-solving skills
- Knowledge of socio-technical systems and risk assessment management

Master's Programs

Major Basic Subjects

Technology Policy Subjects

- Technology Strategy (IL)
- Introduction to Economics of Innovation and Entrepreneurship A
- Economics of Entrepreneurship A
- Innovation Policy A
- Economics of Patent Strategy A

Technology Management Subjects

- Safety Management
- Intellectual Property Strategy (IL)
- Management Systems (IL)
- Project Leadership (IL)
- Risk Assessment and Management
- Value Systems (IL)
- Science Communication
- New Business Creation (IL)
- Introduction to Management Science and Technology
- Value Creation Engineering
- Business Planning (IL)

Technical System Subjects

- Electrical Energy Conversion and Control Equipment Engineering
- Management of Integrated System Technology (IL)
- Carbon Neutral Fundamentals
- Management of Transportation Networks in Social Systems
- Information Affective Engineering

Major General Subjects

- Internship Training
- Advanced Topics A , Advanced Topics C
- Group Studies A
- Seminars
- Master's Thesis Research

Undergraduate Programs

Introduction to Intellectual Property Right ／
Introduction to Management Science and Technology

Spring
Fall
Intensive lecture(IL)
Every Year
Every Other Year

Management Science and Technology Doctoral Programs Curriculum Map

- Theoretical foundational knowledge of economics
- Practical Knowledge of Intellectual Property
- Knowledge of innovation and intellectual property rights

- Practical knowledge of social systems
- Cultivate a broad perspective and problem-solving skills
- Knowledge of socio-technical systems and risk assessment management

Doctoral Programs

Interdisciplinary Basic Subjects

Technology Policy Subjects

- Introduction to Economics of Innovation and Entrepreneurship B
- Economics of Entrepreneurship B
- Advanced Technology Strategy (IL)
- Innovation Policy B (IL)
- Economics of Patent Strategy B

Technology Management Subjects

- Advanced Management Systems (IL)
- Intellectual Property Strategy (IL)
- Project Leadership (IL)
- Value Systems (IL)
- New Business Creation (IL)
- Advanced Theory and Practice of Risk Assessment (IL)
- Value Creation Engineering
- Advanced Management of Integrated System Technology (IL)

Technical System Subjects

- Carbon Neutral Applications
- Advanced Energy Device Engineering (IL)
- Advanced Information Affective Engineering

Major General Subjects

- Advanced Topics B
- Group Studies B
- Doctoral Thesis Research

Master's Programs

Spring
Fall
Intensive lecture(IL)
Every Year
Every Other Year

Important Notes for Students

Reference only, the content of this chapter is the 2024 edition.

Important Notes for Students

1. Announcements and Procedures

(1) Matters regarding communication and announcements from the university to students will be publicized by posting notices. They can be found on the central bulletin board for the School of Engineering (on the first floor of the Central Building for Engineering) and other bulletin boards for each department and related research institute. It is important to make a habit of checking these notices. Especially the matters posted on the central bulletin board for the School of Engineering are treated as being known to all students at the Graduate School of Engineering. Do not overlook them.

(2) The visiting hours for students to the Academic Affairs Division are as follows:

8:30-17:15

Saturdays, Sundays, national holidays (including substitute holidays), summer holidays (Around mid-August), and the year-end and New Year holidays (December 29 to January 3) are not business days.

(3) If you have any questions about procedures, contact the office of your department or the Academic Affairs Division.

Mechanical and Aerospace Engineering	795-7030
Electrical, Information and physics Engineering	795-7185
Applied Chemistry, Chemical Engineering and Biomolecular Engineering	795-7205
Materials Science and Engineering	795-7373
Civil Engineering and Architecture	795-7489
Management Science and Technology	795-3863

Graduate Academic Affairs Section of the Academic Affairs Section	795-5820
Student Support Section of the Academic Affairs Secion	795-5822

	Category	Office/Section in charge	Period	Remarks
School Registry	Issuance of Student ID	Office of your department	At time of enrollment	Student Support Section for reissuance
	Leave of absence, withdrawal, entering	Graduate Academic Affairs Section	As needed	
	Change of address	Student Support Section	As needed	
	Change of family name, transfer, use of maiden name	Student Support Section	As needed	
	Change of parent/guardian	Student Support Section	As needed	
Entranc	Distribution of class timetable	Office of your department	April	
	Registration for classes	Office of your department	April, October	
Tuition/ Scholarships	Payment of tuition	Bank Transfer Payment (Accounting Section)	First semester: late April Second semester: late October	
	The application for admission fee and tuition fee waiver, deferment or monthly installment of tuition payment, etc.	Education and Student Support office Financial Support Section, Student Services Division	First semester: March Second semester: September	
	Scholarships	Student Support Section	Notification by posting	
Health and hygiene	Annual health checkup	Student Health Care Center	Notification by posting	Postal transfer and submit a copy
	Personal Accident Insurance for Students Pursuing Education and Research (*gakkensai*) Liability Insurance coupled with *gakkensai*	Student Support Section	Apply at the time of enrollment	Postal transfer and submit a copy
Other	Issuance of certificates	Graduate Academic Affairs Section	To be applied 2 days before (one week before for English)	Certificate of Completion, Academic Transcript
	Certificate of student discount	Automatic issuing machine* (Student Support Section)	Automatic issuing machine issues documents immediately, however, it may not be available for the year-end and new-year holidays, update at the beginning and end of the fiscal year, and maintenance.	
	Certificate of enrollment (Japanese/English)	Automatic issuing machine* (Student Support Section)		
	Certificate of expected completion (Japanese/English)	Automatic issuing machine* (Graduate Academic Affairs Section)		
	Academic Transcript (Japanese/English)	Automatic issuing machine* (Graduate Academic Affairs Section)		
	Use of field	Student Support Section		
	Use of gymnasium	Student Support Section		
	Use of lecture rooms	Office of your department	As early as possible	
	Fee for Tohoku University Club Association *gakuyu-kai*	Student Support Section		

* The automatic issuing machines for the certificate of enrollment, certificate of student discount, and certificate of expected completion are located at the following sites:
- First floor of the central building, Engineering (Aobayama east area)
- First floor of the Extended Education and Research Building (Katahira area)
- In front of the Undergraduate Academic Affairs Section of Scool of Science (Aobayama Kita area)
- Four other places including Kawauchi-Kita Campus, Kawauchi-Minami Campus, Seiryo Campus, and Aobayama New Campus

2 Enrollment

(1) Student ID

(a) Always carry your student ID with you.

(b) It is required when you borrow books at the library and use the automatic issuing machine for certificates.

(c) If you lose it, bring a picture of you (3 cm x 4 cm) to the Student Support Section for reissuance.

(d) In case of completion, withdrawal or expulsion, return your ID to the Student Support Section.

(e) In case of magnetic loss of your ID, bring your ID to the Academic Affairs Division Education Support Center of Kawauchi-kita Campus and ask them to fix it or ask the Student Support Section of the Academic Affairs Division, the School/Graduate School of Engineering for assistance.

(2) Leave of absence, return to school, withdrawal

Apply to the Graduate Academic Affairs Section in advance. Please note that you may have to pay tuition if you delay your application.

(3) Change of address

Update the information on the Student Affairs Information System immediately after address and contact information change. You can also change it by submitting a change form to the Student Support Section or the office of your department.

(4) Change of family name, transfer, use of maiden name

In case of a change to your family name or the domicile of origin, submit a change notice to the Student Support Section. If you fail to do so, certificates will be issued with the previous information. If you wish to use your maiden's name, submit the designated form to the Student Support Section. You are responsible for any discrepancy between the maiden's name and the name in your family register.

(5) Change of parent/guardian

Please make the change in the Academic Affairs Information System immediately after the change is made. You can also make the change by submitting a change form to the Student Support Section or your department office.

3 Registration

(1) Distribution of class timetable

Class timetables for the first and second semesters will be distributed from the office of your department in April.

(2) Registration for classes

(a) Submit the course registration form to the office of your department at the beginning of the semester according to the instructions of your academic advisor. Detailed procedures will be posted on the board. Courses for which registration is required include related courses and open lectures in addition to your department courses.

(b) When taking courses for other departments or faculties, submit the form in accordance with (a) and ask the department and faculty for instructions to take the prescribed procedures.

(c) Registered courses can be checked on the Student Affairs Information System. You will be told how to access the system at the time of enrollment.

(d) When cancelling a course, notify your academic staff and report the cancellation to the Graduate Academic Affairs Section by the designated date.

(3) Checking grades Courses

You have passed and acquired academic credits for can be checked on the Student Affairs Information System. You will be told how to access the system at the time of enrollment.

Grading criteria are shown below:

Grade	The School of Engineering	Remarks
AA	100-90 points	
A	89-80 points	
B	79-70 points	
C	69-60 points	
D	59-0 points	
F	Fail	This rule applies to grading based only on Pass or Fail.
P	Pass	
E	Class registration has been cancelled by the prescribed procedures.	

(4) Study at other graduate schools

If you wish to receive research guidance at other graduate schools, consult your academic advisor and submit a study application form to the Graduate Academic Affairs Section.

(5) Filing a grading complaint

In case of a question arising from the grade you received in accordance with (3) above, you may file a complaint according to the prescribed procedures.

Guidelines for handling requests for an explanation of your grade
in the Graduate School of Engineering and filing complaints

February 1, 2006

Chairperson of Division Meeting

Requests for explanation and complaints regarding the grade in the Graduate School of Engineering will be handled as follows:

<Requests for an explanation regarding a grade>

Grading criteria and evaluation methods for the Graduate School of Engineering courses will be described in the syllabus and students may ask their academic staff to explain the grade within two weeks after the grade is announced. When there is a good reason for not making a request within this period, the explanation can be requested within one year after the grade is announced and within the grade retention period.

<Filing a complaint>

If students are still not satisfied with the grade after the explanation from their academic staff, they may file a complaint about the grade within one week after the explanation.

<How to file a complaint>

- Prepare the necessary documents and submit them to the following office:

[Office] Graduate Academic Affairs Section, Academic Affairs Division of the Graduate School of Engineering (third floor of the Center Hall, Graduate School of Engineering)

[Necessary Documents] Application form for grading (Exhibit 1)

<Review committee>

- If a complaint is filed against the Dean of the School of Engineering, the Dean shall ask the Graduate School of Engineering Educational Affairs Committee to establish a review committee.
- The review committee will be chaired by the chairperson or vice chairperson of the Graduate School of Engineering Educational Affairs Committee and consist of several committee members appointed by the chairperson.

<Review>

- The review committee will review the complaint regarding the grade brought up by the Dean of the Graduate School of Engineering and determine if the complaint is valid or not. If the committee determines that the complaint is valid, it will respond by clearly indicating the appropriate grade. - The review committee may ask the academic staff to submit materials related to the grade and provide explanations to the committee as necessary. - The review committee may ask the complainant to explain the matters stated in the application form for grading to the committee as necessary.

<Review results>

- The chairman of the review committee will report the review results (Exhibit 2) to the Dean of the Graduate School of Engineering. - The Dean of the Graduate School of Engineering will provide the report from the committee to the complainant. If the complaint is determined to be valid, the Dean of the Graduate School of Engineering will revise the grade to the one recommended by the committee.

Exhibit 1

Month, day, year

Dear Dean of the Graduate School of Engineering,

Application from for grading

I have received an explanation from my academic staff regarding the grade I received for the class below, but I am not satisfied. I would like you to review my grade and inform me of the results.

Sincerely yours,

Student ID number		Name	Seal
Contact information: TEL			
Contact information: E-mail			
Name of Subject		Name of Teacher	
Date of explanation of the grade assessment: DD/MM/YY			
Complaint and reason of complaint (Please provide as detailed an explanation as possible of your class attendance, report submission and examinations sat.)			

Academic Affairs Division use only

(1) Date of receipt of the application form		Remarks
(2) Date of review committee		Grade Correction □No □Yes grade correction date (/)
(3) Date of receipt of the report from the committee		
(4) Date of response(contact)		

Exhibit 2

Month, day, year

Dear Dean of the Graduate School of Engineering,

Review committee
Committee Chairperson ____________________ Seal
Committee members ____________________ Seal
Committee members ____________________ Seal

Report

Regarding the matter submitted to the review committee, we respond as follows:

<table>
<tr><td>Student number</td><td></td><td>Name</td><td></td></tr>
<tr><td>Name of subject</td><td></td><td>Name of Teacher</td><td></td></tr>
<tr><td colspan="4">Review results
☐ As a result of the view, the content of the complaint regarding the grade was found to be valid and it is appropriate that the grade is corrected to the following:
Grade deemed appropriate by the review committee: Points. Pass.
Fail/(Abandonment of Course)
☐ As a result of the review, the content of the complaint regarding the grade was not found to be valid and the grade was given</td></tr>
<tr><td colspan="4">Content of the review</td></tr>
</table>

*The information contained in this report will be disclosed to the complainant.

Guidelines for Research Guidance Plans, etc., for the Graduate School of Engineering

Enacted: January 12, 2022 Council of Department Heads
Amended February 1, 2023 Council of Department Heads

This guideline stipulates the handling of research guidance plans in the Master's and Doctoral Programs of the Graduate School of Engineering, Tohoku University.

1. Target students

The subject of this document is all graduate students enrolled in the Graduate School (excluding students on a leave of absence).

2. Handling of Research Guidance Plans

(1) At the beginning of each academic year (the beginning of October for students admitted in October), the supervisor and research advisor (hereinafter referred to as "supervisor") shall prepare a research guidance plan in the prescribed format and present it to the students.

(2) Teachers will provide guidance in experiments, practical training, surveys and research on research themes based on the research guidance plan.

(3) When it becomes necessary to make changes in the research plan, the faculty member shall hold sufficient discussions with the student and review the research guidance plan as necessary.

3.other

Students on leave of absence will be dealt with after their return to school.

Research Guidance Plan

Academic Year (   ) Enrollment, Admission, and Transfer Student ID: NAME: Major:

Supervising teacher	
Research Supervisor	
Research of study	

Research Guidance Plan
(Filled out by teacher)

1. The faculty member (supervisor and research supervisor) should prepare the research guidance plan and the student should prepare the research plan.
2. For those in their second year or later, please also provide the progress and results of research conducted up to the previous year.
3. The plan must be prepared and presented by the end of May (or the end of November for students admitted in October) of each academic year.

Research plan
(Filled out by student)

5 Awards

Tohoku University selects undergraduate and graduate students who have met the university's educational goals and achieved excellent academic performance and awards them with the President's Award at the time of graduation. The School of Engineering selects students with excellent academic performance, research presentations, and campus activities, and the Graduate School of Engineering selects students with excellent academic performance and research presentations and awards them with the Dean of the Engineering Award or the Dean of the School of Engineering respectively.

6 Study abroad

Tohoku University has concluded academic exchange agreements with a number of partner universities overseas, and actively pursues exchange with these.

For enquiries about study at partner universities and offshore study plans, please contact the Graduate School of Engineering International Education and Exchange Division(Graduate School of Engineering Administration Building, 2F), the Graduate Academic Affairs Section in the Graduate School of Engineering's Academic Affairs Section(Graduate School of Engineering Administration Building,3F)or the International Student Division of the Education and Student Support Department (TEL 795-7820 in the Education and Student Support Center, Kawauchi Campus).

(1)A List of Partner Institutions (as of January 2023)

Inter-University Academic Exchange Agreements

7 Double degree

Tohoku University has a double degree program at the master's level with top-ranked higher education institutions in France and Sweden as partners to develop the next generation of human resources to lead the globalized society.

By participating in this program, students can earn a degree from Tohoku University and a degree from each partner institution.

< Partner Institutions >

(a)France

École Central Group

INSA de Lyon

(b)Sweden

KTH Royal Institute of Technology

For more information, please contact the International Office, School of Engineering (TEL 795-7996) or the International Student Division of the Education and Student Support Department (TEL 795-7820 in the Education and Student Support Center, Kawauchi Campus).

URL: https://www.insc.tohoku.ac.jp/english/degree/doubledegree/

Application Period

The information will be posted on the bulletin board and on the Tohoku University homepage.

8 Tuition and Scholarships

(1) Payment of tuition

Payment of tuition will be withdrawn from the bank registered to the university at the time of enrollment (payment by proxy). Procedures for payment by proxy are handled by the Accounting Section.

(2) Application for Entrance Fee Waiver/Tuition Fee Waiver/Deferment of Collection/Monthly Installment Payment

(a) Students who have been admitted to the University and who are recognized to have extreme difficulty in paying the entrance fee for financial reasons and who are recognized to have excellent academic performance may be granted an exemption from the entrance fee upon their request.

(b) Students who have difficulty paying tuition due to unavoidable circumstances may be exempted from paying tuition by applying.

(c) If it is difficult to pay the tuition fee by the due date, the student must apply for a grace period or permission to pay in monthly installments for each semester.

URL: http://www2.he.tohoku.ac.jp/menjo/index-e.html

(3) Scholarships

Scholarships are offered by the Japan Student Services Organization, local governments, and private organizations. Information on application will be posted at each time on the Student Affairs Information System and the bulletin boards each department. In addition, application information for the Japan Student Services Organization will be posted on the website of the School/Graduate School of Engineering.

URL: https://www.eng.tohoku.ac.jp/english/life/scholership.html

9 Health

(1) Student Health Care Center

The Student Health Care Center aims to maintain and promote student health and offers a variety of activities promoting health.

The Student Health Care Center provides health consultation and medical care at Kawauchi-kita Campus, Katahira Health Care Office, Seiryo Hall Health Care Office, the School of Engineering Health Care Office, and the School of Agriculture Health Care Office. If you have any questions, worries or concerns about your physical or mental health, do not hesitate to use these resources.

URL: https://www.health.ihe.tohoku.ac.jp

(a) Health consultations by specialists Make an appointment before you visit the Center.

Content of consultation	Days	Hours	Remarks
Digestive diseases	Mon., Thu.	9:30-11:30	Student Health Care Center (Kawauchi-kita Campus) 022-795-7829
Mental health	Tue., Thu., Fri.	9:30-11:30(The., Thu., Fri.) 13:00-16:00(Tue., Fri.)	
Circulatory disease	Wed.	9:30-11:30	
Smoking cessation	Tue.	13:00-16:15	

(b) Health consultation and medical care

Make an appointment at a health care office that is convenient for you.

Hours: Weekdays 9:00-11:30, 13:00-16:15 (Mental health: 9:30-11:30, 13:00-16:00)

Name of health care office (Area code 022)	Consultation days	Health Consultations and medical care by School Doctors	
		Category	The days of practice
Student Health Care Center (Kawauchi-kita Campus) 795-7829 Dentistry 795-7830	Mon.-Fri. (am, pm)	Internal medicine	Mon.-Fri. (am, pm)
		Trauma department	Wed.(am), Mon.-Fri.(pm) Mon. (pm), Tue.,Fri. (am)
		Dentistry*	
Katahira Health Care Office	Fri. (pm)	Internal medicine	Fri. (pm)
Seiyo Hall Health Care Office 717-8192	Thu. (pm)	Internal medicine	Thu. (pm)
School of Engineering Health Care Office 795-3667	Tue.(pm)	Internal medicine	Tue. (pm)
School of Agriculture Health Care Office 757-4036	Mon., Wed. (pm)	Internal medicine	Mon., Wed. (pm)

*Appointment necessary

(c) Dietary consultation

Living away from your family tends to lead to an unbalanced diet.

This can adversely affect future health. As an aid for the improvement of an unbalanced diet, dietitians will perform a nutrition diagnosis, tell you how to supplement your diet, what to eat when you dine out, and give tips on how to plan meals during camps. Feel free to visit the center for consultation. (Appointment necessary) TEL 795 -7836

(d) Annual health checkup

Regular health checkup

We will conduct medical examinations for all students from late April to May, and for fall students in October and November, so please be sure to receive medical examinations.

(Net reservation system)

For more information, please check the bulletin board and the Health Management Center website.

If you do not receive a medical examination, you will not be able to issue a medical examination certificate.

(e) Special medical checkup Special medical checkups are provided for students who handle X-rays, organic solvents and specific chemical substances.

If you fall under any of these categories, you must have a special medical checkup.

For details, check the bulletin boards and visit the website of the Student Health Care Center.

Student Health Care Center URL: https://www.health.ihe.tohoku.ac.jp/

(f) Issuance of medical examination certificate (for students who have undergone regular medical examination in the relevant year)

Health examination certificates required for applications for further education, employment, scholarships, etc. are issued by an automatic certificate issuing machine. If you are a non-regular student, please bring your student ID and come to the Health Management Center. Please note the health certificate may not be issued if a specific form or a checkup item is required by the place you submit the certificate to.

How to use the service:

You can either come directly to the Office or arrange an appointment by phone or e-mail.

Consultations can be conducted more smoothly if an appointment is made in advance.

Access: 41 Kawauchi, Aoba-ward, Sendai City, 980-8576 (Kawauchi-kita Campus)

[Contact information]

- Counseling Office

TEL:022-795-7833

E-mail: gakuso@ihe.tohoku.ac.jp

- Disability Services Office

TEL:022-795-7696

E-mail: t-sien@ihe.tohoku.ac.jp

Counseling hours Mon.-Fri. 9:30-17:00

(Except national holidays and the year-end and New Year holidays)

(3) Student Counseling Room in the School/Graduate School of Engineering There are student services offices for each department and Student Counseling Rooms at the School/Graduate School of Engineering (fifth floor of the School of Engineering Administration Building) for

undergraduate and graduate students.

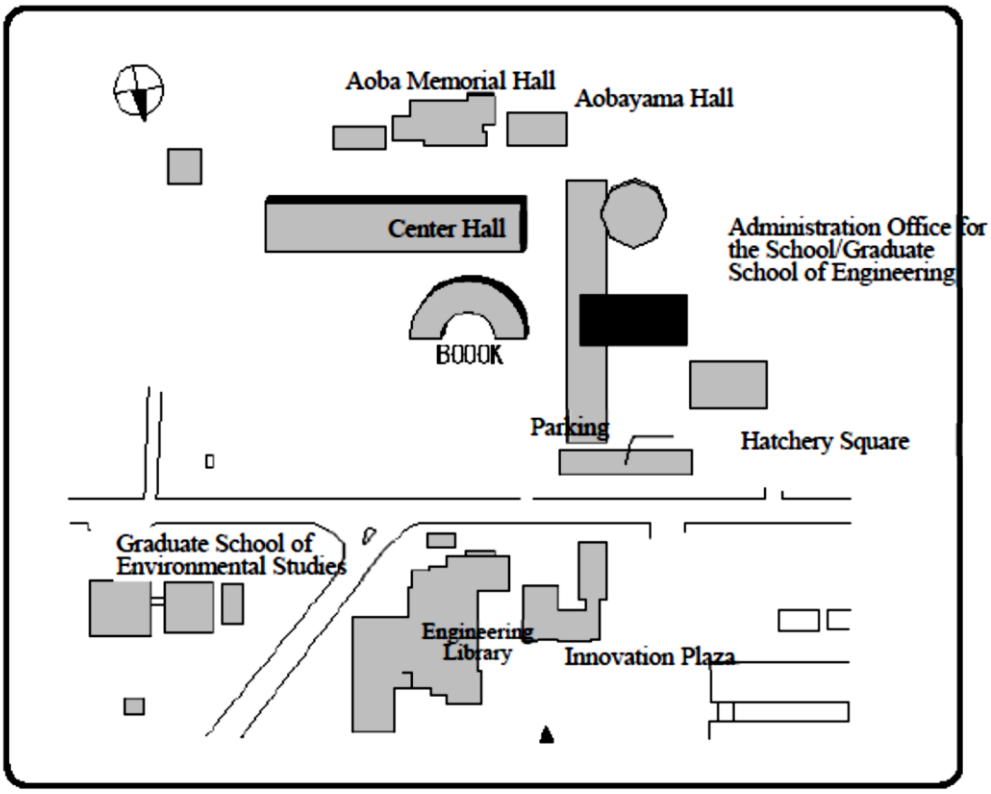
Consult us as soon as possible if you have problems or concerns in your study at the School/Graduate School of Engineering and in your daily life.

The content of consultations is treated as confidential but matters that cannot be solved by counselors alone may be handled by teachers at the instruction section of each department or major, or related committees.

For detailed information including the office hours and contact information of the Counseling Rooms, go to the website of the School of Engineering, and click ‘International Affairs’ -> ‘Counseling Services in School of Engineering’.

You can contact the Counseling Rooms by phone, or e-mail to make an appointment with a counselor.

URL: https://www.eng.tohoku.ac.jp/v-student/gakunai_consultation/counseling/html



11 Prevention of Accidents

(1) Types and causes of accidents

Graduate studies involve sophisticated experiments.

A wide range of social activities can also be required.

There is a possibility of encountering various mishaps and accidents both inside and outside the university, and it is necessary to know well what kind of accidents have occurred.

Carefully read the Safety Manual which includes preventative measures and actively participate in the safety education offered by each major and department.

(a) Accidents during class or study Classes and studies often focus on uncharted territory.

Mishandling laboratory equipment and chemicals can result in serious physical damage, and cause explosions and fires that may injure you or other people.

Therefore, it is necessary to always prepare for every contingency and pay attention to safety.

(b) Accidents during extracurricular activities Actively engaging in extracurricular activities is important for character building.

Since our extracurricular activity facilities and practice areas are scattered throughout the city, many students use motorcycles and cars for travel.

As a result, the number of traffic accidents is increasing as well as the number of accidents caused by playing sports.

In addition, incidents such as acute alcoholic poisoning caused by chugging continue to occur.

Even a prank can lead to serious consequences.

Never force other people to alcohol chugging.

(c) Accidents during commuting

In the Aobayama area, the city streets with heavy traffic and steep slopes, run through the campus, which makes it easy for traffic accidents to occur.

In Sendai, roads are often partially frozen in winter and accidents due to snowfall occur. Snow melting agents as a countermeasure may cause slipping accidents.

Especially in the Aobayama area, it is important to keep in mind that road conditions are bad in winter.

(d) Accidents in personal life Other than the accidents described above, the number of various troubles and incidents in personal life is also increasing with social diversification.

(2) Measures to prevent accidents

We respect students' autonomy, and this requires a level of personal responsibility.

That is the spirit of "at your own risk".

Predicting danger and paying attention to accident prevention are the most basic things as an engineering student.

It is important to bear in mind the principle of responsibility for accidents, to pay attention to safety in ordinary times, and to have the mindset to prevent accidents.

(a) Experiments

You must pay attention to what you wear for experiments.

Common sense about safety such as not exposing the skin or wearing clothes with unnecessary decorations is necessary.

There was an accident in which the hem of a student's clothes got caught in a machine.

In addition, you need to be careful when walking not to touch instruments and machines, and not to knock over chemicals.

A single piece of glass equipment can cause serious injury.

If it ruptures or explodes, it can lead to serious injury or blindness.

Most accidents that caused eye injuries could have been prevented by wearing eye protection.

You need to always stay sharp.

(b) Traffic accidents

In recent traffic accidents, there have been many reports of victims, as well as those who are responsible.

If you are liable, you will be held responsible as a member of society.

In some cases, academic staff of the school or your parents will be summoned.

You may end up causing trouble to many people.

Our university has restrictions on the use of private cars to commute to the campus and many students use motorcycles or bicycles.

Traffic is particularly congested on the way to school.

Make sure to observe traffic regulations on the campus and pay close attention to safety.

When commuting to school by car during winter, be sure to use chains and winter tires due to snow accumulation and icy roads.

Coming to the campus by motorcycle or bicycle in the snow may cause an accident and it should be avoided. Be careful not to drive too fast, especially when it rains, or at intersections and corners. The road surface may have turned icy even when it looks fine.

Regarding accidents and disasters, refer to the Safety Manual and Campus Life Guide.

If you are engaged in operating special equipment in your research, you should actively take related safety seminars.

(3) Measures to be taken in the event of an accident

In the event of an accident during an experiment or research, it is important to immediately raise your voice to draw the attention of people near you. Then you can get help from them and avoid getting people around you involved in the accident. Even if the accident does not seem to be very serious to you, let others know about it so that multiple people can decide what to do. Decisions made by just yourself can often make the accident bigger and increase the risk caused by it. The main principle in dealing with accidents is to keep away dangerous materials and secure an escape route. When the degree of the accident is not large and safety is confirmed, take any required action such as firefighting. When it is confirmed that you can leave the accident site as a result of measures taken, you should immediately contact academic staff or staff member, and ask for subsequent measures. If there are people near you, divide the roles to take immediate action. You can also ask them to get additional help.

If someone is injured by the accident, treat the patient following the points below:

a. Put the patient on the floor/ground to prevent the person from a falling over in shock.
   If the face is flushed, slightly lower his/her head. If the person vomiting, turn the face sideways.

b. Make sure you do not overlook symptoms such as bleeding, burns, and fractures. Immediate measures are necessary for major bleeding, respiratory arrest, and poisoning.

c. When it is necessary to remove their clothes, do not forcefully pull them off, but cut them away.

d. Try not move the patient and keep them warm.

e. Do not make an unconscious patient drink water or other beverages.

f. Do not let the patient see their injuries, encourage them, and keep the crowds away from the site.

If a person is injured, contact the Student Health Care Center. In case of an emergency, contact the emergency room of the Tohoku University Hospital and call the Student Health Care Center. If you require treatment due to an accident that occurred during a class or research, you can receive it at the Tohoku University Hospital at your department's expense. Contact the Student Support Section of the Academic Affairs Division, the School/Graduate School of Engineering to receive a certificate for treatment.

In the event of an accident, it is a general rule to ask for an academic staff's instructions and ask them to contact a fire station or hospital. However, if you cannot reach an academic staff, and if you think it is a life-threatening situation, you should call 119 to get help. (Refer to page 451 of the Accident Response Guidelines for the School/Graduate School of Engineering, Tohoku University) In the event of a disaster such as an earthquake, inform your academic staff or department office of your status. The university has the emergency contact network to confirm the safety of students. Please check it by yourself.

The School/Graduate School of Engineering has collected cases of accidents and mishaps during classes or commuting to improve the safety of students, including near misses and accidents. Read through the Examples of Near Misses and Accidents in the Safety Manual. If you have such an experience, report it to the office of your department.

There may be a variety of incidents, such as theft or other troubles, in addition to accidents.

You should use the Counseling Office in such cases.

(4) Emergency transport to Tohoku University Hospital

When a student at our university becomes a party of a traffic accident near each campus around Sendai City, and needs to be sent to a hospital by ambulance, the Tohoku University Hospital Emergency Center will take the patient on a preferential basis.

You should keep the following points in mind in case you need to be sent to the University Hospital by ambulance:

a. Carry your student ID to prove that you are a Tohoku University student in case you can't express your intention because of a serious accident.

b. If a friend from the university has a severe injury, ask paramedics to take them to the University Hospital.

c. If there is no specific request for a specific hospital from the patient, ask paramedics to take them to the University Hospital. Please note that you or the patient may not be taken to the University Hospital depending on the condition of the injury or the level of urgency.

(5) Disaster compensation

(a)Gakkensai (Personal Accident Insurance for Students Pursuing Education and Research), Gakkenbai (Supplementary Personal Liability Insurance for Students), inbound Futai-gakuso (Comprehensive Insurance for Students' Lives Coupled with Gakkensai for International Students) The School of Engineering requires all students to buy the Gakkensai (Personal Accident Insurance for Students Pursuing Education and Research, including coverage for commuting accidents), Gakkenbai (Supplementary Personal Liability Insurance for Students), or inbound Futai-Gakuso (Comprehensive Insurance for Students' Lives Coupled with Gakkensai for international students) to prepare for accidents during curricular classes, the commute to school, or activities both inside and outside the university.

What is Gakkensai (Personal Accident Insurance for Students Pursuing Education and Research)? It covers accidents occurring during curricular activities, a university event, or extracurricular activity (club activities); while staying in a university facility; or during school commute or while moving between university facilities.

[Reference] http://www.jees.or.jp/gakkensai/

What is Gakkenbai (Liability Insurance for Students Pursuing Education and Research)? *For Japanese students It provides insurance coverage if a student becomes legally obligated to pay damages due to injuring someone or damaging their property during curricular activities, school events, extracurricular activities (note the definition of extracurricular activities; make sure you check the website below), or while commuting to and from such activities.

[Reference] http://www.jees.or.jp/gakkensai/opt-baisho.html

What is inbound Futai-Gakuso (Comprehensive Insurance for Students' Lives Coupled with Gakkensai for International Students)?

*For international students This system provides insurance coverage for injuries, illness, or liability for reparations occurring while you are staying and studying in Japan. You can buy this insurance monthly, depending on how long you study in Japan. This insurance targets international students who have the Gakkensai. If you have this insurance, you will not be required too the gakkennbai.

[Reference] http://www.jees.or.jp/gakkensai/inbound.html

You are required to have Gakkensai, Gakkenbai, and inbound Futai-Gakuso (for international students) at the time of enrollment.

If you have not bought yet, please sign up immediately.

Transfer forms and pamphlets can also be found at the Student Support Section and the Support Planning Section of the Student Support Section at Kawauchi-Kita Campus.

(b) Futai kaigaku (Study Abroad Insurance) It covers illness and injuries occurring during study abroad and during business trips for academic participation approved by Tohoku University.

You need to apply for this insurance at least one month before your departure. All students* who are enrolled in the Gakkensai are eligible.

* You do not need this insurance if you already have overseas travel insurance designated by a travel agency through the arrangement of your airplane ticket and accommodation, or if the destination school (host institution) or overseas study program organizations designates overseas travel insurance.

[Reference] http://www.jees.or.jp/gakkensai/opt-kaigaku.html

If you decide to travel abroad, please be sure to read the following site

[Ancillary marine science (Tohoku University HP) http://www.tohoku.ac.jp/japanese/studentinfo/studentlife/11/studentlife1101/], and apply from the application form (Google Form, university DC mail to log in) at least one month before studying abroad.

* For applications that take less than one month to travel, please contact the support planning staff and check if the procedure is possible. In the unlikely event that you are unable to enroll in ancillary marine science, please be sure to enroll in some kind of overseas travel insurance.

Contact: Support Planning Section, Student Support Division, Education and Student Support Department (Education and Student Support Center No. 1)
TEL: 022-795-7819
E-mail:hoken-gakusei*grp.tohoku.ac.jp
Please convert (* to @ and send an email)

* Importance of Overseas Travel Insurance Many students go abroad to study or attend academic conferences or international conferences. If you go to a hospital overseas due to illness or injury, the medical cost can be very high. You may be charged for an ambulance. The cost may be extremely high when your family members are called to the hospital or if you are transported to Japan by charter airplane. The current social insurance policy in Japan provides coverage for medical expenses overseas. Overseas medical expenses paid by social insurance are calculated based on the level of medical expenses incurred in Japan. In a country where medical expenses are much higher than those in Japan, the difference must be paid out of the patient's own pocket which may raise the amount significantly. This makes enrolling in overseas travel insurance indispensable for overseas travelers. Overseas travel insurance covers medical expenses paid by travelers for illness or injury. You cannot anticipate when a sudden accident or illness will occur. Make sure you buy either the Futai Kaigaku or other overseas travel insurance for unexpected problems.

[Note]
1. You are required to enroll in and pay the premium for overseas travel insurance including the Futai Kaigaku by yourself, except for certain travel plans sponsored by the School/Graduate School of Engineering for which insurance has already been enrolled by them.
2. The Gakkensai does not apply to diseases, and the coverage of the insurance for injuries is limited. Overseas travelers are therefore required to separately enroll in overseas travel insurance including the Futai Kaigaku.
3. Some overseas travel insurance, including insurance that comes with credit cards, does not cover expensive medical treatment. Make sure you check the coverage content before you buy an insurance.
4. In most cases, people with a chronic disease are not eligible for buying insurance, or if they can buy insurance, they will not be compensated for the onset of the chronic disease. Some insurance, however, covers chronic disease. We recommend you buy insurance that covers chronic disease.
5. Overseas travel insurance covers not only illnesses and injuries, but in most cases, death, residual disability, and liability. Some insurance even covers damage to your personal effects. (Futai Kaigaku covers personal effects.)

(6) Accident examples Several dozen accidents involving students in the School/Graduate School of Engineering are reported every year, and most of these are traffic accidents. They include many cases of motorcycle or cycle contact, collision, or falling over accidents, and some serious injuries such as fractures and internal bleeding. Some students were detained by the police for drinking too much at parties. You can drink, but do not get too drunk.

12 Unlawful Acts, Crime Prevention, Criminal Acts

The free atmosphere at the university often lets your guard down. Naturally, a free environment can be sustained by everyone's actions in a sensible manner. We ask you not to get involved in any of the following crimes and keep your guard up so that you will not be taken advantage of.

(1) Unlawful acts and disciplinary action Never cheat in examinations. Any student who has cheated in an examination will be subject to disciplinary action as stipulated in Article 38 of the Graduate School General Rules (suspension, etc.), and all courses taken during the semester will be invalid. Depending on the examination you take, you may be allowed to bring in textbooks and notebooks or asked not to bring anything other than your writing materials.

It is important to understand the instructions of the academic staff for each examination. Students who have committed unlawful acts such as violence, damage to properties, theft, or sexual offenses other than during examinations will be subject to severe criminal punishment, and the university will take severe disciplinary action such as suspension or expulsion. Students are strongly encouraged to always have compassion for others, comply with laws and regulations, and act with common sense and responsibility.

(2) Crime prevention Motorcycles, bicycles, and money have been stolen on campus. In some cases, motorcycles parked outside designated areas were stolen. Automobiles, motorcycles, and bicycles must be parked in designated areas.

In addition, you should be very careful of your personal effects, especially cash and valuables, for the purpose of crime prevention. Cases of theft where a student left a classroom or a laboratory with their wallet carelessly left on their desk have been reported. The lost items may have been reported to the Student Support Section of the Academic Affairs Division, the School/Graduate School of Engineering, or the office of your department.

There was also an incident in which a student who was about to go home after dark was hit on the head with a hammer from behind in a parking area. Unfortunately, it is not always safe on campus. Make sure you are very careful not to suffer theft or incidents.

If by chance you witness such an incident, take necessary measures immediately such as calling a doctor or ambulance, and contact the office of your department or the Security Office (phone 795-5840). Incidents such as drinking too much at parties ending up with hospitalization have occurred outside the campus.

As a citizen, you must strictly refrain from causing trouble to others. There was a serious crime in which a student was arrested on suspicion of complicity in theft. A student was found using another person's motorcycle without permission in the campus parking area. Both students were severely punished.

13 Harassment

(1) University as a society

A university that aims for education and research is a society formed by students, academic staff, and staff members. The personality of all individual comprising society must be respected in every sense. Discriminatory acts based on age, sex, nationality, or mental and physical damage to others must never be tolerated. Any university of good sense, however, needs to expect that a tragic situation may be brought about by an illegal intruder or a member of the university.

(2) What is harassment?

Harassment covered by the university's harassment prevention measures means human rights violations such as sexual harassment, educational harassment, and research harassment.

<Sexual harassment>

Human rights violations through sexual speech and behavior that makes others uncomfortable

[Types of violations]

Non-consensual sexual speech and behavior taking advantage of one's dominant bargaining position

- Sexual speech and behavior that interferes with entering the University, or employment, education, and research environments

Speech and behavior based on an unjust sexist assumption

* Whether speech or behavior amounts to sexual harassment depends on how the recipient perceives it, not how the perpetrator feels.

<Educational and research harassment>

Human rights violations through inappropriate remarks and actions taking advantage of one's dominant bargaining position in education and research (so-called academic harassment and power harassment)

[Types of violations]

- Obstruction of learning and research activities
- Obstruction of graduation or promotion
- Infringement of the right of choice
- Exploitation of research results
- Abandonment of the obligation of guidance and discrimination in guidance
- Compulsion of unjust economic burdens
- Mental abuse
- Violence
- Slander
- Coercion of guidance under inappropriate circumstances
- Abuse of power
- Invasion of privacy
- Power harassment in the workplace

(3) If you feel you have been harassed:

If you feel you have been harassed, you should take courage and clearly express your feelings to the perpetrator. Letting them know how you feel may lead to a solution.

You can also consult with a person you trust, or the Harassment Counseling Center. The University provides the Harassment Counseling Center on and off campus (sexual harassment only off campus). The consultants will protect your privacy and consult with you according to your intention. You will not suffer any repercussions because of such a consultation. Putting up with it and worrying about it by yourself does not solve the problem. Courage and action are the first steps towards a solution.

If someone around, you are victimized by harassment:

If someone around you is victimized by harassment, give a helping hand to the person. It is also necessary to actively cooperate with them, such as giving the perpetrator a warning and taking the victim to the Harassment Counseling Center. There may be victims around you who cannot tell anyone and suffers alone. When you notice harassment, do not become a bystander but help the victim.

(4) Harassment Counseling Center

To deal with harassment cases on campus, we provide the Harassment Counseling Center as shown below:

To Prevent and Resolve Harassment brochure http://c.tohoku.ac.jp/homucomp/harassment/

Confidentiality of consultation contents is strictly protected. Feel safe and consult as soon as possible. You will not suffer any repercussions because of such a consultation.

Harassment Counseling Center on campus

Consultants are available at the Harassment Counseling Center for Students and inquiry counters for each department. Our consultants assigned to the Harassment Counseling Center for Students, including inquiry counters for each department, are listed on the following website:

Graduate School of Engineering, Harassment Prevention Measures:

URL: https://c.tohoku.ac.jp/homucomp/harassment/madoguchi-gakusai/

Inquiry counters	➡	Harassment Counseling Center on campus

Harassment Counseling Center for Students

The Harassment Counseling Center for Students is located on the Kawauchi-kita Campus. Professional consultants, including female consultants, are available for consultation.

Counseling hours

Mon.-Fri. 9:30-17:00 (excluding holidays)

Consultation:

- To have a consultation, make an appointment by phone in advance.
- Consultations are available by phone call and other means, in addition to face-to-face meetings.

(Direct line: voice mail is available)

TEL 022-795-7812

FAX 022-795-3778 (dedicated line)

41 Kawauchi, Aoba-ward, Sendai City, 980-8576

Harassment Counseling Center off campus

Tohoku University has contracted with a specialized firm (T-PEC Corporation) to set up an off-campus consultation service, which can be accessed by phone or via the Internet.

Visit the website below for details.

Tohoku University Harassment Prevention Measures

Inquiry counters	➡	Harassment Counseling Center out of campus

14 Others

(1) Issuance of certificates

(a) When you need a certificate of completion and academic transcript, submit the application form to the Graduate Academic Affairs Section. If you need a certificate other than listed above, submit the request with designated form.

(b) Certificates of expected completion, certificates of enrollment, transcripts, health examination certificates (for students who have undergone regular health examinations in the relevant year) and student discounts are issued by automatic issuing machines at each campus.

(c) When certificates are required for acquisition of various qualifications after the completion of the course, write down the following information in an application form and submit it to the Graduate Academic Affairs Section with a return envelope with the required stamp. Course and major, date of enrollment and completion, name, date of birth, phone number (contact information), type and the number of certificates, reason, and place of submission

* For English certificates, write down your name in romaji in addition to the information listed above.

(d) Certificate for JR student discount

The certificate for a JR student discount is granted to students by the railway company (JR) to allow students to focus on their study. Do not use it improperly.

- To receive the certificate, complete the procedures on the automatic certificate issuance machines. Your student ID is required.
- The maximum number of certificates that can be issued is two per operation. If more than two certificates are required, perform the operation twice or more.
- The certificate for a JR student discount is valid for up to three months.

The maximum number of certificates that can be issued by the automatic certificate issuance machines is 20 certificates per year per student. If you want to be issued with more than 20 certificates, apply to the Student Support Section of the Academic Affairs Division.

(e) Student commuter certificate

The student support section of the Academic Affairs Division issues school certificates necessary for purchasing commuter passes for JR and buses and subways.

If you wish, please bring your student ID and complete the procedure.

The Academic City Sendai City bus/subway free pass can be purchased with your student ID card. (No school certificate required)

(2) Employment

Each department will provide counseling and placement services for employment for students who are expected to complete the School of Engineering.

(3) Suggestion box of the School/Graduate School of Engineering

The School/Graduate School of Engineering has set the suggestion box to ask for students' opinions and comments. If you have any opinions and requests for improvement, post them on the website below or place them in the box located on the first floor of the Center Hall of the School/Graduate School of Engineering.

https://www.eng.tohoku.ac.jp/v-student/gakunai_other/comment.html

Responses to your opinions and requests can be read on the website below and the bulletin board on the first floor of the Center Hall of the School/Graduate School of Engineering.

http://www.eng.tohoku.ac.jp/gakunai_other /response.html

(4) Use of lecture rooms

(a) If students belong to the School of Engineering alone intend to hold a meeting in a lecture room, ask for permission from the Dean of the School of Engineering at least three days before use. Come to the Academic Affairs Division to submit the request.

(b) If students from other departments intend to hold a meeting in a lecture room that belongs to their department, ask permission of the Dean of the department.

(c) Meetings are handled according to the internal regulations for Student Organizations, Meetings, Postings, and Distribution of Printed Materials (page 448).

(5) Use of the Aobayama gymnasium

The gymnasium and field may be used for physical activities by students, academic staff, and staff members. If you want to use them, submit a request for use to the Student Support Section of the Academic Affairs Division at least three days before use.

Use of the Tohoku University Aobayama Gymnasium (“Gymnasium and Field”)

1 The Gymnasium and Field may be used when any of the following conditions apply:

(1) Physical activities of Tohoku University students and staff members

(2) Other reasons deemed appropriate by the Dean of the School of Engineering

2 The Gymnasium and Field are closed on the days listed below:

(1) Saturdays and Sundays

(2) National holidays (When a national holiday falls on Sunday, the following Monday.)

(3) Summer holidays for the School/Graduate School of Engineering

(4) From December 22 to January 3

(5) The days listed above are subject to change.

3 The Gymnasium and Field can be used from 10:00 to 19:00, Monday through Friday.

4 The hours listed above are subject to change.

5 Any person who wants to use the Gymnasium and Field must ask for permission from the Dean of the School of Engineering as provided for separately.

Procedures to use the Tohoku University Aobayama Gymnasium

1 General use

(1) Permission by reservation

(a) For general use, ask for permission of the chairperson of the department or the chairperson of the division and submit the form designated by the School of Engineering at least three days before use.

(b) Applications will be accepted from the first day of the month before the date of use.

(c) Permission will be granted on a first-come, first-served basis. However, if it is difficult to determine which application came first, priority may be determined after discussion.

(d) Regarding the use of the gymnasium from 12:00 to 13:00, Monday through Friday, staff members will be given priority and applicants will adjust the use schedule except under special circumstances.

(e) The field may be used by students, academic staff, and staff members from 12:00 to 13:00, Monday through Friday. To the extent that it does not hinder the use by a person who obtained permission by reservation, applicants will adjust the use schedule. No equipment will be lent out during this time.

(2) Permission not by reservation Students and staff members of the departments and divisions in the Aobayama area who has obtained a permission after applying to the administrator as needed can use the Gymnasium during the hours with no reservation. If this hinders the use by a person who obtained a permission by reservation or permission of special use, permission not by reservation will not be granted.

2 Special use

(1) Use by the member organizations of the Tohoku University Club Association Gakuyu-kai Application for use by the member organizations of the Tohoku University Club Association Gakuyu-kai will be accepted from the first day of the month two months before the date of use. Those in charge of use must belong to the Graduate School of Engineering, School of Engineering, Graduate School of Information Sciences, Graduate School of Environmental Studies, or Graduate School of Biomedical Engineering.

(2) Other special use Applications for the following use will be accepted as special use from the first day of the month six months before the date of use and may be given priority:

(a) General events for the School/Graduate School of Engineering and each department

(b) An application has been submitted by the chairperson of the departments or divisions as a general event or an equivalent event for the department and division in the Aobayama area other than the School/Graduate School of Engineering.

(c) An application has been submitted by the chairperson of the departments or divisions as an event for the department and division other than listed above.

(d) Other use approved by the Dean of the School of Engineering

(3) Use on closed days of the special uses prescribed in the preceding paragraph (2), use on closed days may be permitted only when specially permitted by the Dean of the School of Engineering.

3 Hours of use

As a rule, use of the gymnasium (floor A, floor B) and the field (court C-court H) pursuant to 1 and 2(1) prescribed above will be limited to three hours, five times per month (up to twice for the gymnasium) unless the Dean of the School of Engineering gives special permission.

4 Cancellation of permission

Of the applications mentioned in (1) to (3) above which have already been approved, if the Dean of the School of Engineering finds that there are unavoidable circumstances, the permission may be cancelled and given specially to another applicant.

5 Declination of permission for use If it has been decided not to use the gymnasium after the use permission has been granted, the applicant should promptly decline the use permission so as not to interfere with other uses.

Remarks:

1 The gymnasium may be used by the students, academic staff, and staff members from 12:00 to 13:30, Monday through Friday, for the time being. To the extent that it does not hinder the use by a person who obtained permission by reservation, applicants will adjust the use schedule. No equipment will be lent out during this time.

2 The field may be used by students, academic staff, and staff members from 8:30 to 10:00, Monday through Friday, for the time being. To the extent that it does not hinder the use by a person who obtained permission by reservation, applicants will adjust the use schedule. No equipment will be lent out during this time.

3 Application office Student Support Section of the Academic Affairs Division,
the School/Graduate School of Engineering (TEL: 022-795-5822, extension 4624)
Aobayama gymnasium administrator office (TEL: 022-795-7995)

Guidelines for use of the Aobayama gymnasium

1 Before using the gymnasium, submit the permit for use to the administrator office and fill in the user list. However, in the case of use pursuant to the provision of (2) of the Usage Procedures 1, submission of a permit to use is not required.

2 Do not use the gymnasium for anything other than the permitted purpose and time.

3 Use indoor sports shoes or slippers inside the gymnasium and do not enter with your shoes on.

4 Do not use equipment that has not been approved for use. After using the facilities and equipment, bring the equipment back to its original storage place.

5 In case of damage to the facilities or loss of equipment, notify the administrator office, the Academic Affairs Division, or the security office.

6 The users must clean the gymnasium after use and not leave any garbage.

7 Do not eat or drink inside the gymnasium other than in the designated area (around the vending machine in the lobby).

8 Do not bring any hazardous material into the gymnasium.

9 Do not post anything other than on the bulletin board.

10 There is no parking area.

11 Follow the instructions of the administrator when using the gymnasium.

12 Guidelines for use of the Aobayama field

1) Before using the gymnasium, submit a permit for use to the administrator office and fill in the user list. However, in the case of use pursuant to the provision of (2) of the Usage Procedures 1, submission of a permit to use is not required.

2) Do not use the gymnasium for anything other than the permitted purpose and time.

3) Remove mud from your shoes before using the field.

4) Eating and drinking inside the field is prohibited.

5) When moving and setting heavy objects such as soccer goals and benches, be careful not to damage the artificial turf, and do not leave heavy objects on the turf for a long time.

6) Since artificial turf is not suitable for snow removal work, the field will not be used in case of

snow.

7) Check the surface of the field after use. If the bulking agent is not even, contact the administrator, replenish the agent, and return it to its original condition. Do not leave any garbage behind.

8) Follow the instructions of the administrator when using the gymnasium.

(6) Use of the Aobayama Hall the Aobayama Hall can be used for conferences and meetings for the purpose of improving education and friendship of between the staff members of the School of Engineering. Students may also use the hall as well as academic staff and staff members. Before using the hall, submit the designated request for use to the Student Support Section by the day before the date of use and obtain permission.

1. The Hall is used by academic staff, staff members, and students (including researchers, research students, and non-degree students) of the School of Engineering, Graduate School of Engineering, Graduate School of Information Sciences, Graduate School of Environmental Studies, and Graduate School of Biomedical Engineering, Tohoku University (collectively “School of Engineering”) as a welfare facility.
2. The hall is closed on the days listed below:
   1) Saturday, Sunday
   2) National holidays (When a national holiday falls on Sunday, the following Monday.)
   3) From December 29 to January 3
   4) Other days deemed necessary by the Dean of the School of Engineering
3. When using the hall, the designated permit must be submitted to the dean of the School of Engineering (“Dean”) through the Facility Maintenance Section of the Facility Maintenance Office by staff members, and through the Student Support Section of the Academic Affairs Division, the School/Graduate School of Engineering by students before the date of use.
4. (1) If the Dean finds the application prescribed in the preceding article appropriate, he/she will grant permission subject to the necessary conditions.
   (2) The Dean will issue a use permit when permission has been given for use.
5. The hall can be used from 8:30 to 20:30.
6. Users of the hall must protect the facilities, equipment, and appliances of the hall (“Facilities”) and maintain their order.

15 Tohoku University Komei-kai and the Aoba Kogyo-kai

As noted in Komei-kai's rules, this group comprises students in the Graduate School of Engineering, the School of Engineering, the Graduate School of Information Science, the Graduate School of Biomedical Engineering and the Graduate School of Environmental Studies as well as special members and aims to promote friendship among its members and improve student life.

Members of the club are selected from each major and work under two sections: General Affairs and Sports.

The Athletic Meet organized by the sports division is well-known all over the university as an annual fixture.

It is the role of new members of the Komei-kai both to follow and enhance the group's traditions and to add new projects.

Komei-kai hopes that full advantage will be taken of the organization to help you and your fellow students enjoy a rich and fulfilling campus life.

(See Tohoku university Komei-kai Regulations)

(2) Aoba Kogyo-kai

Komei-kai started out in the very early days of the Graduate School of Engineering as an organization embracing both staff and students across the entire school.

Three divisions were set up to handle sports, recreation and journal publication.

The sports division used the Komei-kai fund to create a track for the Graduate School of Engineering.

The recreation division succeeded in the developing friendship within the school using the Komei-kai meeting hall as its base.

The journal publication division began the annual Komei-kai Journal in the year that the school was founded, preparing a friendly joint space for all graduates, students and teaching staff and bringing them news and views.

When reform of the educational system saw Sendai Kogyo Senmon gakko (SKK; Sendai College of Engineering)absorbed into the Graduate School of Engineering, the relationship between the SKK While there were some twists and turns along the way, in the end all SKK students studying engineering in Sendai were absorbed into the Graduate School of Engineering within the revamped Tohoku university, and it was consequently decided to establish a joint alumni association based on the bonds of friendship between the two schools, which had enjoyed a particularly close relationship since the Meiji period.

On 1 December 1956, more than 250 area representatives from Hokkaido, Tohoku, Kanto, Hokuriku, Chubu, Kinki, Kyushu and elsewhere joined Sendai locals at the Tohoku university Hall for the inaugural meeting, with the new organization launched as the Aoba Kogyo-kai.

The Aoba Kogyo-kai has accordingly emerged as one of the largest and strongest organizations of its type in Japan and is expected to continue to make great strides into the future.

(See *Aoba Kogyo-kai Regulations*, Regulations on f*ee for Aoba Kogyo-kai Regular Members and Student Members* and *Aoba Kogyo-kai Branch Office General Rules*).

16　Common Graduate Courses and Cross-Graduate Courses

Common Graduate School Courses

Tohoku University Graduate School offers "Common Courses for Graduate Schools" to foster creative and energetic researchers and highly specialized human resources across all boundaries, to cultivate a deep understanding of culture, to learn about contemporary social issues, and to acquire transferable skills.

The common graduate school subjects include subjects for "master's degree programs, first two-year programs, and professional degree programs (master's programs, etc.)" and subjects for "second three-year programs, medical degree programs, dental degree programs, and pharmaceutical degree programs (doctoral programs, etc.). These courses can be included in the

completion requirements of the Graduate School as related courses.
Registration procedures vary depending on the subject, so please check the website (https://pgd.tohoku.ac.jp/rpc/subjects.html).

【Common Graduate School Subjects (FY2024)】

Course Title	Credits	curriculum
Intellectual Property seminar	2	MC
Lectures on Interdisciplinary Researches	2	MC
Teaching Development in Higher Education	2	DC
Special Lectures on Interdisciplinary Researches I-II	1 each	DC
Special Exercise on Interdisciplinary Researches I-IV	1 each	DC
Special Exercise for Frontier Research in Interdisciplinary Sciences	1	DC
Basic PhD Literacy	2	DC
Doctoral Internship	1〜2	DC
Renewable energy : Biomass circulation	2	MC/DC
Special Seminar on Multicultural Understanding PBL	2	MC/DC
Special Seminar on Career and Skill Development	2	MC/DC
Master's Internship / Career Training A	1	MC
Master's Internship / Career Training B	2	MC
Intercultural Collaborative Learning and Communication Seminar	2	MC/DC
Global Studies of International Education	2	MC/DC
ILAS Special Lecture A	2	MC/DC
ILAS Special Lecture B	2	MC/DC
ILAS Special Seminar	2	MC/DC

Cross-Graduate Courses

In order to provide graduate students with more opportunities to take courses that have a high degree of commonality, we have compiled a list of "Cross-Graduate Courses" that are offered by each graduate school as well as common graduate courses, have a high degree of commonality, and are recommended for students of other graduate schools.
Please check the website (https://pgd.tohoku.ac.jp/rpc/subjects.html) for course offerings.

Regulations

Disclaimer: This translation is provided for reference purposes only

Tohoku University Graduate School General Rules

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Chapter I General Provisions

Article 1 (1) The Graduate Schools of Tohoku University (hereinafter referred to as the "Tohoku University Graduate Schools") aim to teach and have students study academic theories and applications, have them master these at a profound level or cultivate knowledge in depth and outstanding abilities to engage in professions that require advanced expertise, and thereby contribute to cultural developments in a wide sphere.

(2) Within the structure of the Tohoku University Graduate Schools, professional graduate schools are designed to teach and have students study academic theories and applications, and to cultivate knowledge in depth and outstanding abilities to engage in professions which require advanced expertise.

(3) For each graduate school, major, or course set under the Tohoku University Graduate Schools in accordance with the provisions of the following Article 2 (1) and Article 3, the purpose of its human resource development, and other purposes of its education and research shall be as prescribed in each graduate school's rules.

Article 2 (1) The graduate schools and majors established under the Tohoku University Graduate Schools shall be as follows.

Graduate School of Arts and Letters: Japanese Studies; Global Humanities; Integrated Human Sciences

Graduate School of Education: Educational Science

Graduate School of Law: Law and Society; Public Law and Policy; Legal and Political Studies

Graduate School of Economics and Management: Economics and Management; Accountancy

Graduate School of Science: Mathematics; Physics; Astronomy; Geophysics; Chemistry; Earth Science

Graduate School of Medicine: Medical Sciences; Disability Sciences; Health Sciences; Public Health

Graduate School of Dentistry: Dental Sciences

Graduate School of Pharmaceutical Sciences: Molecular Pharmaceutical Science; Life and Pharmaceutical Science; Pharmacy

Graduate School of Engineering: Mechanical Systems and Design; Finemechanics; Robotics; Aerospace Engineering; Quantum Science and Energy Engineering; Electrical Engineering; Communications Engineering; Electronic Engineering; Applied Physics; Applied Chemistry; Chemical Engineering; Biomolecular Engineering; Metallurgy; Materials Science; Materials Processing; Civil and Environmental Engineering; Architecture and Building Science; Management Science and Technology

Graduate School of Agricultural Science: Agricultural Bioscience;

Graduate School of International Cultural Studies: International Cultural Studies

Graduate School of Information Sciences: Computer and Mathematical Sciences; System Information Sciences; Human-Social Information Sciences; Applied Information Sciences

Graduate School of Life Sciences: Integrative Life Sciences; Ecological Developmental Adaptability Life Sciences; Molecular and Chemical Life Sciences

Graduate School of Environmental Studies: Environmental Studies for Advanced Society; Frontier Science for Advanced Environment

Graduate School of Biomedical Engineering: Biomedical Engineering

(2) The capacities of the graduate schools shall be as specified in Appended Table 1.

(Partially revised on/by Jul. 1, 1955; May 23, 1961; Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 39 of 1972; Rule No. 64 of 1993; Rule No. 21 of 1994; Rule No. 8 of 2001; Rule No. 34 of 2002; Rule No. 8 of 2003; Rule No. 86 of 2004; Rule No. 31 of 2005; Rule No. 60 of 2006; Rule No. 66 of 2008; Rule No. 32 of 2010; Rule No. 31 of 2012; Rule No. 65 of 2015; Rule No. 55 of 2016; Rule No. 38 of 2017; Rule No. 54 of 2018; and Rule No. 60 of 2019)

Article 2-2 (1) In addition to the details set forth in the preceding Article 2, graduate degree programs shall be established, as a category of courses, under the Tohoku University Graduate Schools' doctoral courses prescribed in the following Article.

(2) Matters necessary for graduate degree programs shall be prescribed separately.

(Added by Rule No. 23 of 2013)

Article 3 As specified in Appended Table 1, master's courses, doctoral courses, and professional degree programs shall be established under the Tohoku University Graduate Schools.

(Partially revised on Jan. 1, 1955. Fully revised on Jul. 1, 1955. Partially revised by Rule No. 45 of 1963; and Rule No. 39 of 1972. Fully revised by Rule No. 9 of 1975. Partially revised by Rule No. 8 of 2003; and Rule No. 86 of 2004)

Article 3-2 (1) Doctoral courses of graduate schools other than the Graduate School of Medicine, the Graduate School of Dentistry, and the Graduate School of Pharmaceutical Sciences shall be courses partitioned (hereinafter referred to as a "Partitioned Course") into the first two years (hereinafter referred to as a "First Phase Course") and the latter three years (hereinafter referred to as a "Latter Phase Course"), and First Phase Courses shall be handled as master's courses.

(2) The doctoral course of Medical Sciences of the Graduate School of Medicine shall be a course for the study of medicine (hereinafter referred to as the "Medical Course"), and the doctoral courses of Disability Sciences, and Health Sciences of the Graduate School of Medicine shall be Partitioned Courses.

(3) The doctoral course of the Graduate School of Dentistry shall be a course for the study of dentistry (hereinafter referred to as the "Dental Course").

(4) The doctoral course of Pharmacy of the Graduate School of Pharmaceutical Sciences shall be a course for the study of pharmacy (hereinafter referred to as the "Pharmacy Course"), and the doctoral courses of Molecular Pharmaceutical Science, and Life and Pharmaceutical Science of the Graduate School of Pharmaceutical Sciences shall be Partitioned Courses.

(Added on Jul. 1, 1955. Fully revised by Rule No. 9 of 1975. Partially revised by Rule No. 21 of 1994; Rule No. 31 of 1996; Rule No. 34 of 2002; Rule No. 86 of 2004; Rule No. 32 of 2010; Rule No. 31 of 2012; and Rule No. 54 of 2018)

Article 3-3 The professional degree program of Law and Society of the Graduate School of Law shall be the course taught by the Law School.

(Added by Rule No. 86 of 2004)

Article 3-4 Master's courses and First Phase Courses (hereinafter referred to as "Master's Courses, etc.") aim to deepen students' knowledge from a broad perspective, and cultivate research abilities in their fields of specialization and, in addition, outstanding abilities to engage in professions that require advanced expertise.

(Added by Rule No. 9 of 1975. Partially revised by Rule No. 64 of 1993; and Rule No. 8 of 2003. Former Article 3-3 moved down and partially revised by Rule No. 86 of 2004)

Article 3-5 Latter Phase Courses and the Medical Course, Dental Course, and Pharmacy Course aim to develop advanced research abilities and rich knowledge as the basis of such abilities, which are necessary for students to independently engage in research activities in their fields of specialization as researchers, or to engage in other highly specialized operations.

(Added by Rule No. 9 of 1975. Partially revised by Rule No. 7 of 1979; Rule No. 64 of 1993; Rule No. 21 of 1994; and Rule No. 31 of 1996. Former Article 3-4 moved down by Rule No. 86 of 2004. Partially revised by Rule No. 31 of 2012)

Article 3-6 Professional degree programs aim to cultivate knowledge in depth and outstanding abilities to engage in professions which require advanced expertise.

(Added by Rule No. 86 of 2004)

Article 3-7 The course offered by the Law School aims to provide education solely for the development of legal professions.

(Added by Rule No. 86 of 2004)

Article 4 (1) The standard duration of study for Master's Courses, etc. shall be two years; provided, however, that in cases where it is regarded as necessary for the sake of education or research, such standard duration of study may exceed two years in accordance with each graduate school or major, or the categories of students' modes of study, and pursuant to the provisions of each graduate school's rules.

(2) Notwithstanding the provision of the preceding Article 4 (1), in cases where a Master's Course, etc. provide education principally to persons with practical experience, where it is regarded as necessary for the sake of education or research, and where appropriate means are employed, for example the provision of classes or research guidance during nighttime as well as daytime, during other specific hours, or at specific times, to ensure no obstacle to education is caused, the standard duration of study for such Master's Course, etc. may be changed to a period of at least one year and less than two years in accordance with the graduate school or major concerned, or the categories of students' modes of study, and pursuant to the provisions of the graduate school's rules.

(3) The maximum duration of enrollment for Master's Courses, etc. shall be four years (or twice the standard duration of study, in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period other than two years).

(Partially revised by Rule No. 9 of 1975; and Rule No. 7 of 1990. Fully revised by Rule No. 90 of 1999. Partially revised by Rule No. 34 of 2002; Rule No. 8 of 2003; Rule No. 86 of 2004; Rule No. 66 of 2008; and Rule No. 54 of 2018)

Article 4-2 (1) The standard duration of study for Latter Phase Courses shall be three years; provided, however, that in cases where it is regarded as necessary for the sake of education or research, such standard duration of study may exceed three years in accordance with each graduate school or major, or the categories of students' modes of study, and pursuant to the provisions of each graduate school's rules.

(2) The maximum duration of enrollment for Latter Phase Courses shall be six years (or twice the standard duration of study, in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period exceeding three years).

(Added by Rule No. 90 of 1999. Partially revised by Rule No. 86 of 2004; Rule No. 66 of 2008; and Rule No. 54 of 2018)

Article 5 (1) The standard duration of study for the Medical Course, Dental Course, and Pharmacy Course shall be four years; provided, however, that in cases where it is regarded as necessary for the sake of education or research, such standard duration of study may exceed four years in accordance with each graduate school or major, or the categories of students' modes of study, and pursuant to the provisions of each graduate school's rules.

(2) The maximum duration of enrollment for the courses specified in the preceding Article 5 (1) shall be eight years (or twice the standard duration of study, in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period exceeding four years).

(Partially revised on/by Jul. 1, 1955; Rule No. 45 of 1963; and Rule No. 39 of 1972. Fully revised by Rule No. 9 of 1975. Partially revised by Rule No. 7 of 1979; Rule No. 21 of 1994; Rule No. 31 of 1996; Rule No. 86 of 2004; Rule No. 66 of 2008; and Rule No. 31 of 2012)

Article 5-2 (1) The standard duration of study set for professional degree programs other than the Law School's course shall be two years or a period of at least one year and less than two years.

(2) Notwithstanding the provision of the preceding Article 5-2 (1), in cases where a professional degree program other than the Law School's course provides education principally to persons with practical experience, and where appropriate means are employed, for example the provision of classes during nighttime as well as daytime, during other specific hours, or at specific times, to ensure no obstacle to education is caused, the standard duration of study for the professional degree program may be changed to a period of at least one year and less than two years if the original standard duration is two years, or, if the original standard duration is at least one year and less than two years, a period exceeding this period, in accordance with the relevant graduate school or major, or the relevant category of students' modes of study, and pursuant to the provisions of the relevant graduate school's rules.

(3) The maximum duration of enrollment for professional degree programs other than the Law School's course shall be four years (or twice the standard duration of study, in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period other than two years).

(Added by Rule No. 86 of 2004)

Article 5-3 (1) The standard duration of study set for the Law School's course shall be three years.

(2) The maximum duration of enrollment for completion of the Law School's course shall be six years; provided, however,

that for persons enrolled in the Law School's course and regarded as having basic knowledge of laws (hereinafter referred to as a "Student with Some Legal Knowledge"), the maximum duration of enrollment shall be four years.

(3) The maximum duration of enrollment for acquisition of the necessary credits set for each year of study in the Law School's course shall be two years for each year of study; provided, however, that in the case of sickness or other unavoidable circumstances found while in the Law School's course, the maximum duration of enrollment may be a period exceeding two years per year of study.

(Added by Rule No. 86 of 2004. Partially revised by Rule No. 60 of 2006)

Article 5-4 (1) In cases where a student makes a request to take a curriculum in a systematic manner over a certain period exceeding the applicable standard duration of study due to such circumstances as being in employment or other status, such systematic manner of studying may be permitted in accordance with the provisions of each graduate school's rules.

(2) In cases where a student for whom a systematic manner of studying pursuant to the provision of the preceding Article 5-4 (1) has been permitted (hereinafter referred to as a "Long-Term Course Student") makes a request to shorten the period of such manner of studying, the shortening of such period may be permitted in accordance with the provisions of each graduate school's rules.

(3) Long-Term Course Students may not continue to be enrolled beyond twice the standard duration of study.

(Added by Rule No. 8 of 2003. Former Article 5-2 moved down by Rule No. 86 of 2004. Partially revised by Rule No. 54 of 2018)

Article 6 A year of study shall start from April 1 of a year and end on March 31 of the following year.

(Partially revised by Rule No. 46 of 1963)

Article 7 A year of study shall be divided into the following two semesters.

First semester: from April 1 to September 30

Second semester: from October 1 to March 31 of the following year

(Partially revised by Rule No. 45 of 1963)

Article 8 (1) Regular holidays shall be as follows:

Saturdays and Sundays.

The holidays prescribed in the Act on National Holidays (Act No. 178 of 1948);

June 22 as Tohoku University Foundation Day.

April 1 to April 7 as spring vacation.

July 11 to September 10 as summer vacation; and

December 25 to January 7 of the following year as winter vacation.

(2) In cases where it is necessary, a class may be held on a regular holiday.

(3) The periods of the spring, summer and winter vacations may be changed if necessary.

(4) Temporary holidays shall be prescribed on a case-by-case basis.

(Partially revised by Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 42 of 1973; Rule No. 13 of 1987; Rule No. 64 of 1993; and Rule No. 40 of 2020)

Article 9 Deleted

Chapter II Admission, Readmission, Progression, Transfer Admission, Graduate School Transfer, and Major Transfer

(Fully revised on Jan. 1, 1955; and Apr. 1, 1958. Partially revised on/by Jul. 23, 1958; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 10 (1) The timing of admission, progression, transfer admission, graduate school transfer, or major transfer shall be within 30 days of the beginning of a year of study.

(2) Notwithstanding the provision of the preceding Article 10 (1), the timing of admission, progression, transfer admission, graduate school transfer, or major transfer may be within 31 days of the beginning of the second semester in some cases.

(3) The timing of readmission shall be prescribed on a case-by-case basis.

(Partially revised by Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 9 of 1975; Rule No. 17 of 1977; Rule No. 90 of 1999; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 11 A person who falls under one of the following items and passes the prescribed selection processes may be permitted to enroll in a Master's Course, etc. or professional degree program:

(i) A person who graduated from a university.

(ii) A person upon whom a bachelor's degree was conferred pursuant to the provision of Article 104, Paragraph 7 of the School Education Act (Act No. 26 of 1947; hereinafter referred to as the "Act").

(iii) A person who completed a 16-year curriculum of schooling abroad.

(iv) A person who completed a 16-year curriculum of schooling of a foreign country by taking course subjects in Japan through a correspondence education course provided by a school of such foreign country.

(v) A person who completed a university course of a foreign country (limited to a course upon completion of which the person who completed it is deemed to have completed a 16-year curriculum of schooling of such foreign country) provided by an educational institution in Japan that is recognized, under the schooling system of such foreign country, as a provider of university courses of such foreign country, and that is separately designated by the Minister of Education, Culture, Sports, Science and Technology.

(vi) A person to whom a degree equivalent to a bachelor's degree was conferred after completing a course whose duration of study was at least three years at a foreign university or other foreign school (limited to foreign universities/schools whose comprehensive conditions such as their education and research activities are assessed by a party certified by the government of the foreign country or a relevant organization, or equivalent foreign universities/schools separately designated by the Minister of Education, Culture, Sports, Science and Technology) (including those who completed such course by taking course subjects in Japan through correspondence education provided by a school of the foreign country, or those who completed such course at an educational institution that is recognized under the schooling system of the foreign country and is designated as prescribed in the preceding item);

(vii) A person who completed, after the day designated by the Minister of Education, Culture, Sports, Science and Technology, a specialized course at a specialized training college (limited to such course whose duration of study was at least four years, and which satisfied other standards set by the Minister) separately designated by the Minister.

(viii) A person designated by the Minister of Education, Culture, Sports, Science and Technology.

(ix) A person who was enrolled in a university for at least three years, who completed a 15-year curriculum of schooling abroad, who completed a 15-year curriculum of schooling of a foreign country by taking course subjects in Japan through correspondence education provided by a school of such foreign country, or who completed a university course of a foreign country (limited to such course upon completion of which the person who completed it is deemed to have completed a 15-year curriculum of schooling of such foreign country) provided by an educational institution in Japan that is recognized, under the schooling system of such foreign country, as a provider of university courses of such foreign country, and that is separately designated by the Minister of Education, Culture, Sports, Science and Technology; and furthermore who is found, by the Tohoku University Graduate Schools, to have achieved excellent results in acquiring the prescribed credits;

(x) A person who enrolled in a graduate school of another university pursuant to the provision of Article 102, Paragraph 2 of the Act (hereinafter referred to as "Other Universities' Graduate Schools"), and who is regarded by the Tohoku University Graduate Schools as having academic abilities deserving of receiving the education thereof; or

(xi) A person who is deemed, through an individual university entrance qualification assessment, to have academic abilities at least equivalent to those of university graduates by the Tohoku University Graduate Schools, and who has reached the age of 22.

(Partially revised on Apr. 27, 1954. Fully revised on Jan. 1, 1955. Partially revised on/by Jul. 1, 1955; Rule No. 45 of 1963; Rule No. 9 of 1975; Rule No. 7 of 1990; Rule No. 59 of 1991; Rule No. 79 of 1994; Rule No. 86 of 1999; Rule No. 8 of 2001; Rule No. 146 of 2001; Rule No. 34 of 2002; Rule No. 8 of 2003; Rule No. 169 of 2003; Rule No. 86 of 2004; Rule No. 170 of 2005; Rule No. 60 of 2006; Rule No. 123 of 2006; Rule No. 66 of 2008; Rule No. 80 of 2016; and Rule No. 60 of 2019)

Article 12 A person who falls under one of the following items and passes prescribed selection processes may be permitted to be enrolled in the Medical Course, Dental Course, or Pharmacy Course:

(i) A person who graduated from a university course in medicine, dentistry, pharmacy, or veterinary medicine.

(ii) A person who completed a 18-year curriculum of schooling abroad;

(iii) A person who completed a 18-year curriculum of schooling of a foreign country by taking course subjects in Japan through correspondence education provided by a school of such foreign country;

(iv) A person who completed a university course of a foreign country (limited to such course upon completion of which the person who completed it is deemed to have completed a 18-year curriculum of schooling of such foreign country) provided by an educational institution in Japan that is recognized, under the schooling system of such foreign country, as a provider of university courses of such foreign country, and that is separately designated by the Minister of Education, Culture, Sports, Science and Technology.

(v) A person upon whom a degree equivalent to a bachelor's degree was conferred after completing a course whose duration of study was at least five years at a foreign university or other foreign school (limited to foreign universities/schools whose comprehensive conditions such as their education and research activities are assessed by a party certified by the government of the foreign country or a relevant organization, or equivalent foreign universities/schools separately designated by the Minister of Education, Culture, Sports, Science and Technology) (Including those who completed such course by taking course subjects in Japan through correspondence education provided by a school of the foreign country, or who completed such course at an educational institution that is recognized under the schooling system of the foreign country and designated as prescribed in the preceding item);

(vi) A person designated by the Minister of Education, Culture, Sports, Science and Technology.

(vii) A person who was enrolled in a university course in medicine, dentistry, pharmacy, or veterinary medicine for at least four years, who completed a 16-year curriculum of schooling abroad (limited to schooling that included a curriculum on medicine, dentistry, pharmacy, or veterinary medicine; the same shall apply hereinafter in this item), who completed a 16-year curriculum of schooling of a foreign country by taking course subjects in Japan through correspondence education provided by a school of such foreign country, or who completed a university course of a foreign country (Limited to such course upon completion of which the person who completed it is deemed to have completed a 16-year curriculum of schooling of such foreign country) provided by an educational institution in Japan that is recognized, under the schooling system of such foreign country, as a provider of university courses of such foreign country, and that is separately designated by the Minister of Education, Culture, Sports, Science and Technology; and furthermore who is found, by the Tohoku University Graduate Schools, to have achieved excellent results in acquiring the prescribed credits.

(viii) A person who enrolled in any of Other Universities' Graduate Schools pursuant to the provision of Article 102, Paragraph 2 of the Act (limited to cases where the studying at such graduate school included a course in medicine, dentistry, pharmacy, or veterinary medicine), and who is regarded by the Tohoku University Graduate Schools as having academic abilities deserving of receiving the education thereof; or

(ix) A person who is deemed, through an individual university entrance qualification assessment, to have academic abilities at least equivalent to those of university graduates by the Tohoku University Graduate Schools, and who has reached the age of 24.

(Fully revised on Jan. 1, 1955; and Jul. 1, 1955. Partially revised by Rule No. 45 of 1963; Rule No. 39 of 1972; Rule No. 17 of 1977; Rule No. 7 of 1990; Rule No. 21 of 1994; Rule No. 31 of 1996; Rule No. 86 of 1999; Rule No. 8 of 2001; Rule No. 146 of 2001; Rule No. 34 of 2002; Rule No. 169 of 2003; Rule No. 170 of 2005; Rule No. 66 of 2008; Rule No. 31 of 2012; and Rule No. 80 of 2016)

Article 13 The readmission of a person who withdrew or was expelled from the Tohoku University Graduate Schools mid-course and applies for readmission (limited to readmission to the same major as the one in which he/she was enrolled) may be permitted through selection processes in accordance with the provisions of each graduate school's rules.

(Partially revised by Rule No. 45 of 1963. Fully revised by Rule No. 26 of 1969. Partially revised by Rule No. 34 of 2002; Rule No. 178 of 2006; and Rule No. 54 of 2018)

Article 14 A person who has completed a master's course, First Phase Course, or professional degree program, and applies for continuous progression to a Latter Phase Course or the Medical Course, Dental Course, or Pharmacy Course (Including cases in which the graduate school or major for which the person applies is different from those associated with his/her master's course, First Phase Course, or professional degree program) may be, through selection processes, permitted to proceed to the course applied for in accordance with the provisions of each graduate school's rules.

(Fully revised on Jan. 1, 1955. Partially revised by Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 9 of 1975; Rule No. 34 of 2002; Rule No. 86 of 2004; Rule No. 31 of 2012; and Rule No. 54 of 2018)

Article 15 Transfer admission to a professional degree program other than Latter Phase Courses and the Law School's course may be permitted for a person who falls under one of the following items and passes the prescribed selection processes, in accordance with the provisions of each graduate school's rules:

(i) A person who holds a master's degree or professional degree.

(ii) A person upon whom a degree equivalent to a master's degree or professional degree was conferred by a graduate school of a foreign university (hereinafter referred to as a "Foreign Graduate School");

(iii) A person who, in Japan, took the course subjects of a corresponding education course provided by a foreign school, and consequently upon whom a degree equivalent to a master's degree or professional degree was conferred;

(iv) A person who completed a foreign graduate course provided by an educational institution in Japan that is recognized, under the schooling system of the relevant foreign country, as a provider of graduate courses of the foreign country, and that is separately designated by the Minister of Education, Culture, Sports, Science and Technology (hereinafter referred to as an "Educational Institution providing Foreign Graduate Courses"), and thereafter upon whom a degree equivalent to a master's degree or professional degree was conferred.

(v) A person who completed a course at the United Nations University (hereinafter referred to as the "United Nations University"), which was founded on the basis of the United Nations General Assembly Resolution of December 11, 1972, as set forth in Article 1, Paragraph 2 of the Act on Special Measures Incidental to Enforcement of the "Agreement between the United Nations and Japan Regarding the Headquarters of the United Nations University" (Act No. 72 of 1976), and thereafter upon whom a degree equivalent to a master's degree was conferred.

(vi) A person who studied on the basis of a curriculum of a foreign school, Educational Institution providing Foreign Graduate Courses, or the United Nations University, passed an examination and assessment equivalent to those prescribed in Article 16-2 of the Standards for the Establishment of Graduate Schools (Ordinance of the Ministry of Education, Science and Culture No. 28 of 1974), and is found to have academic abilities at least equivalent to those of master's degree holders.

(vii) A person designated by the Minister of Education, Culture, Sports, Science and Technology; or

(viii) A person who is deemed, through an individual university entrance qualification assessment, to have academic abilities at least equivalent to those of master's degree holders or professional degree holders by the Tohoku University Graduate Schools, and also, who has reached the age of 24.

(Fully revised on Jan. 1, 1955. Partially revised by Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 94 of 1972; Rule No. 9 of 1975; Rule No. 17 of 1977; Rule No. 7 of 1990; Rule No. 86 of 1999; Rule No. 8 of 2001; Rule No. 146 of 2001; Rule No. 34 of 2002; Rule No. 169 of 2003; Rule No. 86 of 2004; Rule No. 31 of 2005; Rule No. 170 of 2005; Rule No. 97 of 2010; Rule No. 85 of 2012; and Rule No. 54 of 2018)

Article 16 (1) A transfer to another graduate school or transfer admission to the Tohoku University Graduate Schools may be permitted, through selection processes, for a person falling under one of the following items, in accordance with the provisions of each graduate school's rules:

(i)A person who is enrolled in one of the Tohoku University Graduate Schools, and applies for a transfer to another graduate school during his/her course

(ii)A person who is enrolled in any of Other Universities' Graduate Schools, and applies for a transfer to the Tohoku University Graduate Schools during his/her course; or

(iii)A person who is enrolled in a Foreign Graduate School or foreign institution of higher education equivalent thereto (hereinafter refer to as a "Foreign Graduate School, etc."), enrolled in a foreign graduate course at an Educational Institution providing Foreign Graduate Courses in Japan (limited to persons prescribed in Article 102, Paragraph 1 of the Act), or enrolled in a course at the United Nations University, and who applies for transfer admission to the Tohoku University Graduate Schools during his/her course.

(2) A major transfer within a graduate school during a person's current major may be permitted through selection processes, in accordance with the provisions of the graduate school's rules.

(3) In applying for a transfer to another graduate school or major in accordance with the provision of Article 16 (1), the written permission of the Dean of the applicant's current graduate school, or that of the president of his/her university, shall be attached to his/her application form.

(Fully revised on Jan. 1, 1955; and Apr. 1, 1958. Partially revised on/by Jul. 23, 1958; Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 94 of 1972; Rule No. 42 of 1973; Rule No. 34 of 2002; Rule No. 170 of 2005; Rule No. 66 of 2008; Rule No. 97 of 2010; and Rule No. 54 of 2018)

Article 16-2 A person who has been admitted to or transferred to this graduate school has completed a course at this graduate school, another graduate school, a foreign graduate school, etc., or a foreign graduate school before enrolling or transferring to this graduate school. Credits earned for classes taken in the educational curriculum of an educational facility or United Nations University (hereinafter referred to as "educational facility with a foreign graduate school program, etc.")

(University Establishment Standards as applied mutatis mutandis in Article 15 of the Graduate School Establishment Standards) Includes credits earned as a non-degree student as stipulated in Article 31, Paragraph 1 (Ministry of Education Ordinance No. 28 of 1955) and as a special course student as stipulated in Paragraph 2 of the same article.) may be considered as credits earned at this graduate school if the graduate school deems them to be educationally useful, pursuant to the regulations of the graduate school.

(2) For Master's Courses, etc., Latter Phase Courses, or the Medical Course, Dental Course, or Pharmacy Course, the number of credits that may be deemed as those acquired at the Tohoku University Graduate Schools in accordance with the provision of the preceding Article 16-2 (1) shall be up to 10 credits.

(3) For professional degree programs other than the Law School's course, the number of credits that may be deemed as those acquired at the Tohoku University Graduate Schools in accordance with the provision of Article 16-2 (1), together with the number of credits deemed as acquired under Article 31-5 (1), shall be up to half of the 30 credits or more set as a requirement for completion of such professional degree programs.

(4) For the Law School's course, the number of credits that may be deemed as those acquired at the Tohoku University Graduate Schools in accordance with the provision of Article 16-2 (1), together with the number of credits deemed as acquired under Article 31-5 (1) (excluding credits that are deemed to have been acquired in excess of 30 credits in accordance with the provision of Article 31-5 (3), shall be up to 30 credits.

(5) Notwithstanding the provisions of the preceding paragraph, a person who has already completed the law and who has completed the basic course of cooperation prescribed in Article 6, Paragraph 2, Item 1 (hereinafter referred to simply as the "basic course of cooperation law") (hereinafter referred to simply as the "basic course of cooperation law") of the law (Law No. 139 of 2002; hereinafter referred to as the "cooperation law"). The number of credits that can be regarded as having been acquired at this graduate school is Article 31-5, Paragraph 1 and Article 3 The number of credits that can be regarded as having been acquired from the provisions of Article 5 and Article 35-4 shall be up to 46 credits. (Excluding units that are deemed to have been acquired in excess of 46 units pursuant to the proviso of Article 31-5, Paragraph 4.)

(Added by Rule No. 21 of 1994. Partially revised by Rule No. 34 of 2002; Rule No. 86 of 2004; Rule No. 170 of 2005; Rule No. 97 of 2010; Rule No. 31 of 2012; Rule No. 85 of 2012; Rule No. 65 of 2015; Rule No. 55 of 2016; and Rule No. 54 of 2018)

Article 16-3 With regard to a person whose readmission, transfer to another graduate school, transfer admission, or transfer to another major is permitted, the course subjects already taken, the number of credits already acquired, and the term of study already spent by such person may be recognized in part or in whole upon deliberation by the Faculty Meeting or Graduate School Committee (hereinafter referred to as the "Faculty Meeting, etc.").

(Added by Rule No. 26 of 1969. Partially revised by Rule No. 42 of 1973; Rule No. 9 of 1975; and Rule No. 64 of 1993. Former Article 16-2 moved down by Rule No. 21 of 1994. Partially revised by Rule No. 29 of 2000; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 17 A person who intends to apply for admission, progression, transfer admission, or a transfer to another graduate school or major shall submit an application form by the prescribed due date for such admission or transfer. A person who intends to apply for readmission shall submit an application form at the time of his/her application.

(Fully revised on Jan. 1, 1955. Partially revised on/by Apr. 1, 1958; Jul. 23, 1958; Rule No. 26 of 1969; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 18 (1) A person who intends to apply for admission, readmission, or transfer admission shall pay an application fee with his/her application form.

(2) The amount of the application fee in the preceding Article 18 (1) shall be as specified in Appended Table 2.

(Partially revised on/by Jan. 1 of 1955; Apr. 1, 1956; Apr. 1, 1958; Rule No. 45 of 1963; Rule No. 20 of 1966; Rule No. 39 of 1972; Rule No. 32 of 1975; Rule No. 53 of 1991; and Rule No. 86 of 2004)

Article 19 (1) A person whose admission, readmission, or transfer admission has been permitted shall pay an admission fee by the prescribed due date, unless such person has applied for an admission fee waiver or deferment of admission fee payment.

(2) The permitted admission, readmission, or transfer admission of a person who has failed to pay the admission fee in the

preceding Article 19 (1) by the prescribed due date shall be revoked.

(3) The amount of the admission fee in Article 19 (1) shall be as specified in Appended Table 2.

(Fully revised on Apr. 27, 1954. Partially revised on/by Jan. 1, 1955; Apr. 1, 1956; Apr. 1, 1958; Rule No. 45 of 1963; Rule No. 20 of 1966; Rule No. 39 of 1972; Rule No. 32 of 1975; Rule No. 17 of 1977; Rule No. 8 of 2003; and Rule No. 86 of 2004)

Article 19-2 (1) In cases where a person whose admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission has been permitted is found to experience difficulty in paying his/her admission fee due to financial reasons, such person may be granted a full or partial admission fee waiver or the deferment of admission fee payment, provided that the academic performance of such person is regarded as excellent.

(2) In addition to the person prescribed in the preceding Article 19-2 (1), a person who is found to experience significant difficulty in paying his/her admission fee due to special circumstances may be granted a partial or full admission fee waiver or the deferment of admission fee payment.

(3) The handling of the admission fee waiver and deferment of admission fee payment prescribed in the preceding Article 19-2 (1) and (2) shall be prescribed separately.

(Added by Rule No. 17 of 1977. Partially revised by Rule No. 79 of 1996 ;and Rule No. 8 of 2003)

Article 20 (1) Any paid application fee or admission fee shall not be refunded.

(2) Notwithstanding the provision of the preceding Article 20 (1), in cases where a screening with application documents, etc. has been carried out (hereinafter referred to as the "First Stage Screening") and a screening of the academic abilities and other details of only those applicants who have passed the First Stage Screening (hereinafter referred to as the "Second Stage Screening") is to be implemented, the amount for the Second Stage Screening in the application fee prescribed in Article 18 shall be refunded to persons who have failed in the First Stage Screening, upon the request of such persons.

(Partially revised by Rule No. 26 of 1969; Rule No. 42 of 1973; Rule No. 32 of 1975; Rule No. 13 of 1987; Rule No. 86 of 2004; and Rule No. 34 of 2014)

Article 21 (1) A person whose admission, readmission, or transfer admission has been permitted shall submit the written declaration prescribed by Tohoku University (hereinafter referred to as the "University") by the prescribed due date.

(2) The permitted admission, readmission, or transfer admission of a person who has failed to submit the written declaration in the preceding Article 21 (1) by the prescribed due date shall be revoked.

Chapter III Leave of Absence

Article 22 (1) A person who is unable to study for a continuous period of three months or more due to sickness or other accident may apply for permission for leave of absence by following the prescribed procedures.

(2) A period of leave of absence shall not exceed a continuous period of one year; provided, however, that a leave of absence for more than one year may be permitted under special circumstances.

(3) A period of leave of absence shall not exceed two years in the case of Master's Courses, etc. (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period other than two years, the same number of years as such standard duration of study), three years in the case of Latter Phase Courses (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period exceeding three years, the same number of years as such standard duration of study), four years in the case of the Medical Course, Dental Course, and Pharmacy Course (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period exceeding four years, the same number of years as such standard duration of study), two years in the case of professional degree programs other than the Law School's course (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study, is a period other than two years, the same number of years as such standard duration of study), and one year in each year of study in the case of the Law School's course; provided, however, that an extension may be permitted under special circumstances, upon request.

(4) A person on leave may request permission to return to study when the ground for his/her leave of absence has ceased to exist.

(Partially revised on Jan. 1, 1955. Fully revised on Jul. 1, 1955. Partially revised by Rule No. 45 of 1963; Rule No. 9 of 1975; Rule No. 7 of 1979; Rule No. 21 of 1994; Rule No. 31 of 1996; Rule No. 90 of 1999; Rule No. 8 of 2003; Rule No. 86 of 2004; Rule No. 66 of 2008; Rule No. 31 of 2012; and Rule No. 54 of 2018)

Article 23 (1) A person who is regarded as unfit for study due to sickness or other circumstances may be ordered to take a leave of absence.

(2) A person on leave shall be ordered to return to study when the ground for his/her leave of absence has ceased to exist.

(Partially revised on Jul. 1, 1955)

Article 24 If a period of leave of absence continuously extends to three months or more, that period shall not be included in the term of study.

Chapter IV University Transfer, Withdrawal, and Expulsion

Article 25 A person who intends to transfer to Other Universities' Graduate Schools shall apply for permission for such transfer with the reason therefor.

(Partially revised by Rule No. 94 of 1972; and Rule No. 42 of 1973)

Article 26 A person who intends to withdraw from the Tohoku University Graduate Schools shall apply for permission for such withdrawal with the reason therefor.

Article 27 A person falling under any of the following items shall be expelled:

(i) A person who is found unlikely to achieve graduation due to sickness or other accident.

(ii) A person who has failed to complete his/her course or acquire the necessary number of credits after the applicable maximum duration of enrollment prescribed in Article 4 (3), Article 4-2 (2), Article 5 (2), Article 5-2 (3), or Article 5-3 (2) or (3) has elapsed.

(iii) Those who have not been granted admission fee exemption or deferment of collection; those who have been granted exemption or deferral of collection of two-thirds, half, or one-third of the amount; or those who have had their permission for exemption or deferment of collection revoked. Those who do not pay the admission fee by the specified date.

(iv) A person who failed to pay his/her tuition, and has still failed to pay it even after having received a demand; or

(v) A person who is not able to study even after the period of leave of absence prescribed in Article 22 (3) has passed.

Chapter V Educational Methods, etc.

(Fully revised by Rule No. 9 of 1975)

Article 28 (1) The education of master’s Courses, etc., Latter Phase Courses, and of the Medical Course, Dental Course, and Pharmacy Course shall be delivered in the form of classes for course subjects and guidance on the preparation, etc. of academic dissertations (hereinafter referred to as "Research Guidance").

(2) The education of professional degree programs shall be delivered in the form of classes for course subjects.

(Partially revised by Rule No. 26 of 1969. Fully revised by Rule No. 9 of 1975. Partially revised by Rule No. 86 of 2004; and Rule No. 31 of 2012)

Article 28-2 (1) Classes shall be conducted by giving lectures, seminars, experiments, laboratory work, or practical training, or combinations thereof.

(2) Classes under the preceding Article 28-2 (1) may be held in places other than classrooms, etc. for such classes by utilizing various types of media in a sophisticated manner, as separately prescribed by the Minister of Education, Culture, Sports, Science and Technology.

(Added by Rule No. 86 of 2004)

Article 28-3 (1) In teaching classes under the preceding Article 28-2 (1), professional graduate schools shall employ appropriate methods such as case study, field study, bidirectional or multidirectional discussion, and question-and-answer sessions in accordance with their major fields, in order to ensure that practical education to accomplish the purposes of such classes is provided.

(2) Professional graduate schools may teach classes in their major fields in places other than classrooms, etc. for such classes, in cases where the relevant graduate schools find that sufficient educational effects can be ensured in this manner in light of the provision of the preceding Article 28-2 (2).

(Added by Rule No. 86 of 2004)

Article 28-4 In cases where a graduate school finds it especially necessary for the sake of education, classes or Research Guidance may be provided during nighttime or other specific hours, or at specific times.

(Added by Rule No. 64 of 1993. Partially revised by Rule No. 21 of 1994; and Rule No. 34 of 2002. Former Article 28-

2 moved down by Rule No. 86 of 2004. Partially revised by Rule No. 54 of 2018)

Article 28-5 (1) The method of calculation of each credit for course subjects shall be based on the standard in which a credit of a course subject consists of contents that require 45 hours of study, and shall follow the criteria below:

(i) For lectures and seminars, classes within the range of 15 to 30 hours in duration shall be treated as one credit.

(ii) For experiments, laboratory work, and practical training, classes within the range of 30 to 45 hours in duration shall be treated as one credit; and

(iii) In the case where a course subject consists of combinations of two or more of lectures, seminars, experiments, laboratory work, and/or practical training, classes for a certain duration taking account of the criteria in the preceding two items according to the actual combinations shall be treated as one credit.Article 28-5 (2) Notwithstanding the provision of the preceding Article 28-5 (1), in cases where the awarding of credits through evaluation of academic achievements is regarded as more appropriate for course subjects relating to academic dissertations, etc., the actual number of credits shall be set by taking account of the amount of study necessary for such course subjects.

(Added by Rule No. 86 of 2004. Partially revised by Rule No. 178 of 2006)

Article 28-6 Article 28-6 In principle, the teaching period for one academic year shall be 35 weeks.

(Added by Rule No. 86 of 2004)

Article 28-7 Classes in each subject shall be conducted in units of 8 weeks, 10 weeks or 15 weeks or other appropriate periods specified by each graduate school so that sufficient educational effects can be achieved.

(Added by Rule No. 86 of 2004. Partially revised by Rule No. 90 of 2013; and Rule No. 54 of 2018)

Article 28-8 Each graduate school shall in advance specify the methods and contents of its classes and Research Guidance, the class and Research Guidance schedule for each year of study, and the criteria for evaluation of academic achievements and dissertations, and for approval of course completion (for each professional graduate school, the methods and contents of classes, the class schedule for each year of study, and the criteria for evaluation of academic achievements, and for approval of course completion).

(Added by Rule No. 86 of 2004. Partially revised by Rule No. 178 of 2006; and Rule No. 54 of 2018)

Article 28-9 Each professional graduate school shall set an upper limit of credits that students can register as their course subjects during a year of study or semester, in order to enable them to properly take course subjects during each year of study.

(Added by Rule No. 86 of 2004)

Article 28-10 A person who intends to take course subjects offered by other graduate schools shall receive permission by following the prescribed procedures.

(Added by Rule No. 86 of 2004. Partially revised by Rule No. 54 of 2018)

Article 29 For those who have taken regular classes in the course of this graduate school and have taken the prescribed course subjects, the examination and other appropriate methods specified by each graduate school at the prescribed time (hereinafter referred to as "examination, etc.") Evaluate the results of the study and give the prescribed credits.

2 The method of examination, etc. shall be determined by the faculty meeting, etc.

(Partially revised on/by Jul. 1, 1955; Rule No. 45 of 1963; and Rule No. 26 of 1969. Fully revised by Rule No. 9 of 1975. Partially revised by Rule No. 64 of 1993; and Rule No. 29 of 2000. Former Article 30 brought forward by Rule No. 86 of 2004)

Article 29-2 Prescribed credits shall be awarded to persons who have passed their examinations.

(Added by Rule No. 86 of 2004)

Article 30 In addition to the provisions in this Chapter, other matters necessary in relation to educational methods shall be separately prescribed.

Chapter V, Paragraph 2 Studying at Other Universities' Graduate Schools, etc., and Study Abroad, etc.

(Chapter title added by Rule No. 94 of 1972. Fully revised by Rule No. 9 of 1975)

Article 31 If the graduate school deems that it is educationally beneficial for a student to take courses at another graduate school, it shall be consulted with the other graduate school in advance so that the student may take courses at the other graduate school. Students may be permitted to take the course.

2 The provisions of the preceding paragraph shall apply mutatis mutandis to cases where a student takes courses in correspondence education in Japan, and cases where a student takes courses in Japan in the curriculum of a foreign

graduate school at an educational institution, etc. The correspondence education is provided by foreign graduate schools.

3 Notwithstanding the provisions of the preceding paragraph, if the graduate school deems that there are special circumstances, the graduate school may omit consultation with the foreign graduate school, etc.

(Partially revised on Jul. 1, 1955. Fully revised by Rule No. 26 of 1969; and Rule No. 94 of 1972. Partially revised by Rule No. 9 of 1975; Rule No. 158 of 2001; Rule No. 34 of 2002; Rule No. 86 of 2004; Rule No. 170 of 2005; Rule No. 97 of 2010; Rule No. 55 of 2016; and Rule No. 54 of 2018)

Article 31-2 In cases where a graduate school finds it educationally beneficial for students to receive Research Guidance at Other Universities' Graduate Schools, research institutes, etc. (hereinafter referred to as "Other Universities' Graduate Schools, etc."), or Educational Institutions, etc. providing Foreign Graduate Courses, the graduate school may, upon prior consultation with such Other Universities' Graduate Schools, etc. or Educational Institutions, etc. providing Foreign Graduate Courses, allow students to receive part of their Research Guidance at such places. In this case, the period during which master course students and First Phase Course students may receive such Research Guidance shall not exceed one year.

(Added by Rule No. 9 of 1975. Partially revised by Rule No. 7 of 1979; Rule No. 7 of 1990; Rule No. 34 of 2002; Rule No. 8 of 2003; Rule No. 170 of 2005; Rule No. 97 of 2010; and Rule No. 54 of 2018)

Article 31-3 If the graduate school deems it educationally beneficial for a student to study at a foreign graduate school, etc., the student may study at the foreign graduate school, etc. after consultation with the foreign graduate school, etc. may be recognized.

2 Notwithstanding the provisions of the preceding paragraph, if the graduate school deems that there are special circumstances, the graduate school may omit consultation with the foreign graduate school, etc.

3 The period of study abroad will be counted in the number of years enrolled.

4 The provisions of paragraphs 1 and 2 shall apply mutatis mutandis to cases where a student studies at a foreign graduate school, etc. during a leave of absence. (1) In cases where a graduate school finds it educationally beneficial for students to take course subjects offered by Other Universities' Graduate Schools, the graduate school may, upon prior consultation with such Other Universities' Graduate Schools, allow students to take such course subjects.

(2) The provision of the preceding Article 31 (1) shall apply mutatis mutandis to cases in which students take course subjects in Japan through correspondence education provided by Foreign Graduate Schools, etc., or in which students in Japan take course subjects in the curricula of Foreign Graduate Schools through Educational Institutions, etc. providing Foreign Graduate Courses.

(3) Notwithstanding the provision of the preceding Article 31 (2), consultation with the relevant Foreign Graduate Schools, etc. may be omitted if the graduate school finds there are special circumstances.

(Added by Rule No. 94 of 1972. Former Article 31-2 moved down by Rule No. 9 of 1975. Partially revised by Rule No. 7 of 1979; Rule No. 158 of 2001; Rule No. 34 of 2002; Rule No. 86 of 2004; and Rule No. 54 of 2018)

Article 31-4 (1) For Master's Courses, etc., Latter Phase Courses, and the Medical Course, Dental Course, and Pharmacy Course, credits acquired by taking course subjects pursuant to the provisions of Article 31 (1) and (2), Research Guidance received pursuant to the provision of Article 31-2, and achievements made by studying abroad and/or by studying while on leave of absence pursuant to the provisions of the preceding Article 31-3 (1) and (4), shall be deemed as credits acquired, or Research Guidance received, at the Tohoku University Graduate Schools in accordance with the provisions of each graduate school's own rules.

Article 31-4 (2) The number of credits that may be deemed as those acquired at the Tohoku University Graduate Schools in accordance with the provision of the preceding Article 31-4 (2) shall be up to 10 credits.

(Added by Rule No. 94 of 1972. Former Article 31-3 moved down and partially revised by Rule No. 9 of 1975. Partially revised by Rule No. 158 of 2001; Rule No. 34 of 2002; Rule No. 86 of 2004; Rule No. 31 of 2012; and Rule No. 54 of 2018)

Article 31-5 (1) For professional degree programs, credits acquired by taking course subjects pursuant to the provisions of Article 31 (1) and (2), and achievements made by studying abroad and/or by studying while on leave of absence pursuant to the provisions of Article 31-3 (1) and (4), shall be deemed as credits acquired at the Tohoku University Graduate Schools in accordance with the provisions of each graduate school's own rules.

(2) The number of credits that may be deemed as those acquired at the Tohoku University Graduate Schools in accordance with the provision of the preceding Article 31-5 (1), together with the number of credits deemed as acquired under Article 16-2 (1), shall be up to half of the 30 credits or more set as a requirement for completion of such professional degree

programs.

(3) Notwithstanding the provision of the preceding Article 31-5 (2), for the Law School's course, the number of credits that may be deemed as those acquired at the Tohoku University Graduate Schools, together with the number of credits deemed as acquired under Article 16-2 (1), or Article 35-4, shall be up to 30 credits; provided, however, that in the case where more than 93 credits are necessary as a requirement for course completion, more than 30 credits may be deemed as acquired only in relation to the portion exceeding the 93 credits.

(4) Notwithstanding the provisions of the preceding two paragraphs, for those who have completed the Collaborative Basic Course for Lawyers, the number of credits that may be deemed to have been acquired at this graduate school may be up to 46 credits, including those deemed to have been acquired pursuant to the provisions of Article 16-2, paragraph 1 and Article 35-4.The number of credits that can be deemed to have been acquired at this graduate school for those who have completed the Collaborative Basic Course for Lawyers is up to 46 credits, including the number of credits deemed to have been acquired under the provisions of Article 16-2, Paragraph 1 and Article 35-4. However, in cases where more than 93 credits are required for completion of the course, the number of credits in excess of 93 credits shall be limited to 46 credits.
However, when the requirement for completion is more than 93 credits, students may be deemed to have acquired more than 46 credits, but only for the number of credits in excess of 93 credits.

Chapter VI Course Completion and Academic Degree Conferral

(Fully revised by Rule No. 9 of 1975)

Article 32 (1) The completion of a master's course or First Phase Course shall require at least two years of enrollment (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study is a period other than two years, such standard duration of study), the acquisition of at least 30 credits for course subjects, the submission of a master's dissertation or research results based on a specific topic (hereinafter referred to as a "Master's Dissertation, etc.") upon receipt of the necessary Research Guidance and in line with the purpose of the Master's Course, etc., and the passing of the review of such dissertation or research results, and the final examination, in accordance with the provisions of the graduate school's rules; provided, however, that with regard to the term of study, one year or more of enrollment shall be sufficient for persons whose research achievements are regarded as outstanding by the Faculty Meeting, etc.

(2) In the case referred to in the preceding Article 32 (1) (limited to cases of the completion of a First Phase Course), if it is found necessary to accomplish the purposes of a relevant doctoral course, the passing of the examination and assessment specified in the following items may be set as a requirement for the completion of a First Phase Course in lieu of the passing of the review of a master’s Dissertation, etc. and the final examination, in accordance with the provisions of the relevant graduate school's rules:

(i) An examination on highly specialized knowledge and abilities in relation to the major field concerned, and on matters that constitute a basic background of fields associated with the major field concerned and that should be acquired or developed during the First Phase Course; and

(ii) An assessment of abilities that are necessary for independent execution of research associated with the person's doctoral dissertation, and that should be acquired during the First Phase Course.

(Partially revised on/by Jul. 1, 1955; Rule No. 45 of 1963; and Rule No. 26 of 1969. Fully revised by Rule No. 9 of 1975. Partially revised by Rule No. 7 of 1990; Rule No. 64 of 1993; Rule No. 90 of 1999; Rule No. 29 of 2000; Rule No. 34 of 2002; Rule No. 8 of 2003; Rule No. 86 of 2004; Rule No. 178 of 2006; Rule No. 66 of 2008; Rule No. 85 of 2012; and Rule No. 54 of 2018)

Article 33 (1) A Master's Dissertation, etc. shall be sufficient to demonstrate the knowledge and ability specified in Article 3-4.

(2) A Master's Dissertation, etc. shall be submitted by the prescribed deadline date during the term of study.

Article 33-2 (1) The completion of a doctoral course as a Partitioned Course shall require at least three years of enrollment
In the relevant Latter Phase Course (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study is a period exceeding three years, such standard duration of study.
For a student who has completed the Law School's course, two years [in the case where the standard duration of study set For the relevant graduate school or major, or the relevant category of students' modes of study is a period exceeding three

years, a period obtained by subtracting one year from such standard duration of study]; and the same shall apply in Article 34 (3)), the submission of a doctoral dissertation upon receipt of the necessary Research Guidance, and the passing of the review of such dissertation, and the final examination, in accordance with the provisions of the graduate school's rules; provided, however, that about the term of study for a person who falls under one of the following items, and whose research achievements are regarded as outstanding by the Faculty Meeting, etc., the period of enrollment specified in the applicable item below shall be sufficient:

(i) A person who completed a master's course or First Phase Course with a standard duration of study of two years or more: one year or more

(ii) A person who completed a master's course or First Phase Course with a standard duration of study of at least one year and less than two years, or whose term of study until his/her completion of a master's course or First Phase Course was at least one year and less than two years: three years or more including the term of study spent for such course

(iii) A person who completed a professional degree program other than the Law School's course with a standard duration of study of at least one year and less than two years: three years or more including such standard duration of study

Article 33-2 (2) In addition to the provision of the preceding Article 33-2 (1), only in the case where it is found especially necessary in terms of Research Guidance, the completion of course subjects during a Latter Phase Course may be set as a requirement for the completion of a doctoral course, in accordance with the provisions of the relevant graduate school's rules.

(Added by Rule No. 9 of 1975. Partially revised by Rule No. 7 of 1979; Rule No. 7 of 1990; Rule No. 64 of 1993; Rule No. 21 of 1994; Rule No. 31 of 1996; Rule No. 29 of 2000; Rule No. 34 of 2002; Rule No. 86 of 2004; Rule No. 66 of 2008; Rule No. 32 of 2010; Rule No. 31 of 2012; and Rule No. 54 of 2018)

Article 33-3 (1) The completion of the Medical Course, Dental Course, or Pharmacy Course shall require at least four years of enrollment (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study is a period exceeding four years, such standard duration of study; the same shall apply in the following Article 34 (3)), the acquisition of at least 30 credits for course subjects, the submission of a doctoral dissertation upon receipt of the necessary Research Guidance, and the passing of the review of such dissertation, and the final examination, in accordance with the provisions of the relevant graduate school's rules; provided, however, that with regard to the term of study, at least three years of enrollment shall be sufficient for persons whose research achievements are regarded as outstanding by the Faculty Meeting, etc.

Article 34 (1) A doctoral dissertation shall be sufficient to demonstrate the research ability and knowledge specified in Article 3-5.

(2) A doctoral dissertation shall be, in principle, submitted during the term of study. In this case, this submission shall be completed by the prescribed deadline date.

(3) A person who failed to submit a doctoral dissertation during the period prescribed in the preceding Article 34 (2) and withdrew from the university may submit his/her doctoral dissertation if such submission is within one year from the day of his/her withdrawal, provided that he/she earned the prescribed credits for the relevant course subjects and received the necessary Research Guidance in the case where he/she was enrolled in a Latter Phase Course for at least three years and belonged to a graduate school whose requirements for completion include the provision of Article 33-2 (2),.3 or that he/she earned the prescribed credits for the relevant course subjects and received necessary Research Guidance in the case where he/she was enrolled in the Medical Course, Dental Course, or Pharmacy Course for at least four years.

(Partially revised on/by Jan. 1, 1955; Jul. 1, 1955; Dec. 15, 1960; Rule No. 45 of 1963; Rule No. 26 of 1969; Rule No. 21 of 1971; Rule No. 39 of 1972; Rule No. 9 of 1975; Rule No. 7 of 1979; Rule No. 64 of 1993; Rule No. 21 of 1994; Rule No. 31 of 1996; Rule No. 29 of 2000; Rule No. 86 of 2004; Rule No. 170 of 2005; Rule No. 66 of 2008; Rule No. 31 of 2012; and Rule No. 54 of 2018)

Article 35 The completion of a professional degree program other than the Law School's course shall require at least two years of enrollment (in the case where the standard duration of study set for the relevant graduate school or major, or the relevant category of students' modes of study is a period other than two years, such standard duration of study), and the completion of the prescribed curriculum, for example the acquisition of at least 30 credits for course subjects, in accordance with the provisions of the relevant graduate school's rules.

(Fully revised by Rule No. 86 of 2004)

Article 35-2 With regard to professional degree programs other than the Law School's course, in cases where credits are

deemed to have been acquired at the Tohoku University Graduate Schools pursuant to the provision of Article 16-2 (1), and where the acquisition of such credits is regarded as the completion of part of the relevant curriculum, a period of up to half of the relevant standard duration of study may be included in the student's term of study; provided, however, that even in this case, at least one year of enrollment is required.
(Added by Rule No. 86 of 2004)

Article 35-3 The completion of the Law School's course shall require at least three years of enrollment, and the acquisition of at least 96 credits for course subjects in accordance with the provisions of the graduate school's rules.
(Added by Rule No. 86 of 2004)

Article 35-4 For a Student With Some Legal Knowledge in the Law School's course, in accordance with the provisions of the graduate school's rules, a period of up to one year may be included in the term of study prescribed in the preceding Article 35-3; with regard to the credits under the same Article, up to 30 credits including those deemed as acquired pursuant to the provision of Article 31-5 (1) (excluding credits deemed as acquired in excess of 30 credits pursuant to the provision of the proviso of Article 31-5 (3)) may be deemed as acquired at the Tohoku University Graduate Schools.
(Added by Rule No. 86 of 2004. Partially revised by Rule No. 55 of 2016)

(2) Notwithstanding the provision of the preceding paragraph, the number of credits that may be deemed to have been acquired at this graduate school for those who have completed the Collaborative Basic Course for Lawyers shall be the number of credits deemed to have been acquired pursuant to the provisions of Article 16-2, paragraph 1 and Article 31-5, paragraph 1 (excluding credits deemed to have been acquired in excess of 46 credits pursuant to the proviso of paragraph 4 of the same Article).The number of credits that can be deemed to have been acquired at this graduate school for students who have completed the basic course is up to 46 credits, including credits deemed to have been acquired pursuant to Article 16-2, Paragraph 1 and Article 31-5, Paragraph 1 (excluding credits deemed to have been acquired in excess of 46 credits pursuant to the proviso of Paragraph 4 of the same article). (2) The maximum number of credits that can be earned by a student is 46 credits (excluding credits deemed to have been earned in excess of 46 credits pursuant to the proviso of paragraph 4 of the same Article).

Article 36 (1) A master's degree shall be conferred on each person upon his/her completion of a master's course or First Phase Course. A doctoral degree shall be conferred on each person upon his/her completion of a doctoral course. A professional degree shall be conferred on each person upon his/her completion of a professional degree program.

(2) In conferring a master's degree pursuant to the provision of the preceding Article 36 (1), the title of the relevant major field shall be appended in accordance with the following categorization:
Graduate School of Arts and Letters: Degree of Master (Literature)
Graduate School of Education: Degree of Master (Education or Educational Informatics)
Graduate School of Law: Degree of Master (Law)
Graduate School of Economics and Management: Degree of Master (Economics or Business Administration)
Graduate School of Science: Degree of Master (Science)
Graduate School of Medicine: Degree of Master (Medical Sciences, Disability Sciences, Nursing Sciences, Health Sciences, or Public Health)
Graduate School of Dentistry: Degree of Master (Oral Sciences)
Graduate School of Pharmaceutical Sciences: Degree of Master (Pharmaceutical Sciences)
Graduate School of Engineering: Degree of Master (Engineering)
Graduate School of Agricultural Science: Degree of Master (Agricultural Science)
Graduate School of International Cultural Studies: Degree of Master (International Cultural Studies)
Graduate School of Information Sciences: Degree of Master (Information Sciences)
Graduate School of Life Sciences: Degree of Master (Life Sciences)
Graduate School of Environmental Studies: Degree of Master (Environmental Studies)
Graduate School of Biomedical Engineering: Degree of Master (Biomedical Engineering)

(3) In conferring a doctoral degree pursuant to the provision of Article 36 (1), the title of the relevant major field shall be appended in accordance with the following categorization:
Graduate School of Arts and Letters: Degree of Doctor (Literature)
Graduate School of Education: Degree of Doctor (Education or Educational Informatics)

Graduate School of Law: Degree of Doctor (Law)
Graduate School of Economics and Management: Degree of Doctor (Economics or Business Administration)
Graduate School of Science: Degree of Doctor (Science)
Graduate School of Medicine: Degree of Doctor (Medicine, Disability Sciences, Nursing Sciences, or Health Sciences)
Graduate School of Dentistry: Degree of Doctor (Dentistry)
Graduate School of Pharmaceutical Sciences: Degree of Doctor (Pharmaceutical Sciences or Pharmacy)
Graduate School of Engineering: Degree of Doctor (Engineering)
Graduate School of Agricultural Science: Degree of Doctor (Agricultural Science)
Graduate School of International Cultural Studies: Degree of Doctor (International Cultural Studies)
Graduate School of Information Sciences: Degree of Doctor (Information Sciences)
Graduate School of Life Sciences: Degree of Doctor (Life Sciences)
Graduate School of Environmental Studies: Degree of Doctor (Environmental Studies)
Graduate School of Biomedical Engineering: Degree of Doctor (Biomedical Engineering)

(4) In addition to the provisions of the preceding Article 36 (2) and (3), when a master's degree or doctoral degree is conferred, the title of the relevant major field may be appended as "Degree of Master (Academic Field)" or "Degree of Doctor (Academic Field)."

(5) Professional degrees to be conferred pursuant to the provision of Article 36 (1) shall be as follows:
Graduate School of Law: Degree of master’s in public law and Policy (Professional Degree), or Juris Doctor (Professional Degree)
Graduate School of Economics and Management: Degree of master’s in accountancy (Professional Degree)

Article 37 In addition to the provisions in this Chapter, the requirements for conferral of master's degrees, doctoral degrees, and professional degrees, and other matters necessary in relation to academic degrees shall be as prescribed in the Regulations on Tohoku University Academic Degrees (established on January 1, 1955).

Chapter VII Disciplinary Action

Article 38 (1) Any person who violates any regulations or orders of Tohoku University or acts contrary to his/her duties as a student, shall be subject to disciplinary action through prescribed procedures.

(2) The available types of disciplinary action shall be reprimand, suspension, and expulsion.

(3) In cases where a suspension from Tohoku University extends to three months or more, the period of such suspension shall not be included in the term of study.

Chapter VIII Tuition

Article 39 (1) The amount of each tuition shall be as specified in Appended Table 2.

(2) Notwithstanding the provision of the preceding Article 39 (1), the annual amount of tuition for each Long-Term Course Student shall be the amount obtained by dividing, by the number of years in his/her term of study, the product of the annual amount of tuition prescribed in the aforementioned Article 39 (1) multiplied by the standard duration of study.

(3) The payment of tuition shall be divided into two installments, one in the first semester and the other in the second semester. The amount due in each semester shall be an amount equivalent to half of the annual amount of tuition.

(4) The tuition stated in the preceding Article 39 (3) shall be paid in April for the first semester, and in October for the second semester, unless the student concerned applies for permission for a tuition waiver or deferment, or for monthly installment payment; provided, however, that the tuition for the second semester may be paid at the same time as the tuition for the first semester.

(Partially revised on Apr. 1, 1956. Fully revised on Apr. 1, 1957. Partially revised by Rule No. 45 of 1963; Rule No. 39 of 1972; Rule No. 42 of 1973; Rule No. 32 of 1975; and Rule No. 17 of 1977. Fully revised by Rule No. 13 of 1987. Partially revised by Rule No. 8 of 1991; Rule No. 8 of 2003; Rule No. 86 of 2004; and Rule No. 33 of 2007)

Article 40 A person who returns to study or is readmitted to Tohoku University during the first or second semester shall pay, within the month of his/her return or readmission, the tuition for the semester obtained by multiplying an amount equivalent to one-twelfth of the annual amount of his/her tuition (hereinafter referred to as the "Calculated Monthly Amount") by the number of months from the month of his/her return or readmission to the last month of the semester concerned.

(Partially revised on Apr. 1, 1956. Fully revised on/by Apr. 1, 1957; Rule No. 45 of 1963; and Rule No. 42 of 1973)

Article 41 A person who is expected to complete his/her course in the middle of a year of study shall pay the tuition obtained by multiplying the Calculated Monthly Amount by the number of months up to the month of his/her expected completion, in April if the tuition concerned is for his/her term of study in the first semester, or in October if it is for his/her term of study in the second semester.

(Partially revised on Jul. 1, 1955; and Apr. 1, 1956. Fully revised on/by Apr. 1, 1957; Rule No. 45 of 1963; and Rule No. 42 of 1973)

Article 41-2 A Long-Term Course Student who is permitted to shorten his/her term of study in accordance with the provision of Article 5-4 (2) shall immediately pay the tuition obtained by multiplying the annual amount of his/her tuition calculated according to the shortened period and on the basis of the provision of Article 39 (2) by the number of years in the elapsed period of his/her enrollment, and then by deducting, from this product, the total amount of the tuition that should be paid for the elapsed period of his/her enrollment.

(Added by Rule No. 8 of 2003. Partially revised by Rule No. 86 of 2004)

Article 42 (1) Unless otherwise provided for, a person who has withdrawn himself/herself from Tohoku University, has transferred to another university, or has been expelled or ordered to withdraw himself/herself from Tohoku University shall pay the tuition for the semester.

(2) A person to whom an order of suspension is given shall pay the tuition for the period of such suspension.

(Fully revised on Apr. 1, 1957)

Article 43 (1) A person who is found to experience difficulty in paying his/her tuition due to financial reasons, and whose academic performance is regarded as excellent or who is found to have other unavoidable circumstances, may be granted a full or partial tuition waiver or tuition payment deferment or may be ordered to pay his/her tuition by monthly installments.

(2) The handling of the tuition waiver, tuition deferment, and monthly installment payment under the preceding Article 43 (1) shall be prescribed separately.

(Partially revised on Apr. 1, 1956. Fully revised on/by Apr. 1, 1957; Rule No. 45 of 1963; Rule No. 26 of 1969; and Rule No. 42 of 1973)

Article 44 (1) Paid tuition shall not be refunded.

(2) Notwithstanding the provision of the preceding Article 44 (1), in cases where a person who had paid his/her tuition for both the first and second semesters at the same time in accordance with the provision of the proviso of Article 39 (4) took a leave of absence or withdrew from Tohoku University before the due time for the tuition for the second semester, an amount equivalent to the tuition for the second semester shall be refunded at the request of such person.

(Fully revised on Apr. 1, 1957. Partially revised by Rule No. 26 of 1969; Rule No. 42 of 1973; Rule No. 13 of 1987; Rule No. 53 of 1991; Rule No. 86 of 2004; and Rule No. 33 of 2007)

Article 44-2 In addition to the provisions in this Chapter, other matters necessary for the handling of tuition shall be prescribed separately.

Chapter IX Credited Auditors

(Added on Dec. 15, 1960. Fully revised by Rule No. 21 of 1994)

Article 44-3 In cases where a person applies to take a course subject or more of his/her choice among those offered by the Tohoku University Graduate Schools (including related course subjects), the graduate school concerned may permit, through selection processes, the enrollment of such person as a Credited Auditor only if such enrollment will not obstruct other students' study.

(Added on Dec. 15, 1960. Partially revised by Rule No. 26 of 1969; Rule No. 9 of 1975; Rule No. 21 of 1994; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 44-4 The timing of enrollment of a Credited Auditor shall be at the beginning of a semester.

(Added on Dec. 15, 1960. Partially revised by Rule No. 42 of 1973; and Rule No. 21 of 1994)

Article 44-5 The entrance eligibility, term of study, and other details of Credited Auditors shall be as prescribed in each graduate school's rules.

(Added on Dec. 15, 1960. Partially revised by Rule No. 21 of 1994; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 44-6 (1) A person who applies for admission to Tohoku University as a Credited Auditor shall pay an application fee with his/her application form.

(2) The amount of the application fee shall be as specified in Appended Table 2.

(Added on Dec. 15, 1960. Partially revised by Rule No. 45 of 1963; Rule No. 20 of 1966; Rule No. 39 of 1972; Rule No. 32 of 1975; Rule No. 21 of 1994; and Rule No. 86 of 2004)

Article 44-7 (1) A person whose admission to Tohoku University as a Credited Auditor has been permitted shall pay an admission fee by the prescribed due date.

(2) The permission of admission of a person who has failed to pay the admission fee under the preceding Article 9 (1) by the prescribed due date shall be revoked.

(3) The amount of the admission fee shall be as specified in Appended Table 2.

(Added on Dec. 15, 1960. Partially revised by Rule No. 45 of 1963; Rule No. 20 of 1966; Rule No. 39 of 1972; Rule No. 32 of 1975; Rule No. 21 of 1994; and Rule No. 86 of 2004)

Article 44-8 (1) Prior to the beginning of classes in each semester, Credited Auditors shall pay their tuition for the semester in advance.

(2) The amount of tuition shall be as specified in Appended Table 2.

(Added on Dec. 15, 1960. Partially revised by Rule No. 45 of 1963; Rule No. 39 of 1972; Rule No. 32 of 1975; Rule No. 21 of 1994; and Rule No. 86 of 2004)

Article 44-9 A certificate of the acquisition of credits may be issued to Credited Auditors in accordance with the provisions of each graduate school's rules.

(Added on Dec. 15, 1960. Partially revised by Rule No. 26 of 1969; Rule No. 21 of 1994; Rule No. 34 of 2002; and Rule No. 54 of 2018)

Article 44-10 In addition to the provisions in this Chapter, provisions pertaining to graduate students shall apply mutatis mutandis to Credited Auditors.

Chapter IX, Paragraph 2 Special Auditing Students and Special Research Students

(Added by Rule No. 94 of 1972. Fully revised by Rule No. 57 of 1975)

Article 44-11 In cases where students of Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses apply to take course subjects offered by the Tohoku University Graduate Schools, each graduate school may accept such students as Special Auditing Students, as prescribed through consultation with such Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses.

(2) Notwithstanding the provisions of the preceding paragraph, students enrolled in the joint law school basic course at our university or another university that have concluded a legal training partnership agreement with our university as stipulated in Article 6, Paragraph 1 of the Collaboration Act and who wish to take courses at the law school. If there are applicants, they may be accepted as special auditing students at the law school, as stipulated in the relevant agreement.

(Added by Rule No. 94 of 1972. Partially revised by Rule No. 42 of 1973; Rule No. 9 of 1975; Rule No. 34 of 2002; Rule No. 170 of 2005; Rule No. 97 of 2010; Rule No. 54 of 2018; and Rule No. 40 of 2020)

Article 44-12 In cases where students of Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses apply to receive Research Guidance at the Tohoku University Graduate Schools, each graduate school may accept such students as Special Research Students, as prescribed through consultation with such Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses.

(Added by Rule No. 57 of 1975. Partially revised by Rule No. 7 of 1979; Rule No. 7 of 1990; Rule No. 34 of 2002; Rule No. 170 of 2005; Rule No. 97 of 2010; and Rule No. 54 of 2018)

Article 44-13 (1) The timing of acceptance of Special Auditing Students shall be at the beginning of a semester.

(2) The timing of acceptance of Special Research Students shall be, in principle, at the beginning of a semester.

(3) Notwithstanding the provision of Article 44-13 (1), in cases where Special Auditing Students to be accepted are students of Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses, the accepting graduate school may determine the timing of such acceptance on a case-by-case basis if there are special circumstances.

(Added by Rule No. 94 of 1972. Partially revised by Rule No. 32 of 1975. Former Article 44-12 moved down and partially revised by Rule No. 57 of 1975. Partially revised by Rule No. 34 of 2002; Rule No. 170 of 2005; Rule No. 97 of 2010; and Rule No. 54 of 2018)

Article 44-14 No application fee and admission fee shall be collected when accepting Special Auditing Students and Special Research Students.

(Added by Rule No. 94 of 1972. Former Article 44-13 moved down and partially revised by Rule No. 57 of 1975)

Article 44-15 (1) When accepting a person falling under one of the following items as a Special Auditing Student or Special Research Student, no tuition shall be collected:

(i) A graduate student of a national university; or

(ii)A student from a graduate school of a public or private university, if a university-level mutual credit transfer agreement or university-level special research student exchange agreement (each including university-level agreement, department-level agreement, and any other similar agreement) stipulates that no tuition is to be collected for students from such graduate school.

(iii) A student of a Foreign Graduate School, etc. that has executed a university-level exchange agreement (including university-level agreements, department-level agreements, and other similar agreements; hereinafter the same shall apply) under which no tuition is to be collected for such student; or

(iv) A student of Coordinated Introductory Law Programs referred to in Article 44-11 (2).

(Added by Rule No. 94 of 1972. Partially revised by Rule No. 32 of 1975. Former Article 44-14 moved down and partially revised by Rule No. 57 of 1975. Fully revised by Rule No. 53 of 1991. Partially revised by Rule No. 5 of 1997; Rule No. 111 of 1998; Rule No. 86 of 2004; Rule No. 123 of 2006; Rule No. 55 of 2016; and Rule No. 40 of 2020)

Article 44-16 (1) The amount of tuition for a Special Auditing Student or Special Research Student who does not fall under any of the items of the preceding Article 44-15 shall be as specified in Appended Table 2.

(2) With regard to Special Auditing Students, the tuition under the preceding Article 44-16 (1) for a semester shall be collected before the beginning of their classes during the semester. With regard to Special Research Students, the tuition under the preceding Article 44-16 (1) for each three-month period starting from the month of their acceptance shall be collected in the first month of each three-month period; if the period of acceptance is less than three months, the tuition for this period shall be collected in the first month of the same period.

(Added by Rule No. 94 of 1972. Former Article 44-15 moved down and partially revised by Rule No. 57 of 1975. Partially revised by Rule No. 53 of 1991; Rule No. 21 of 1994; Rule No. 5 of 1997; Rule No. 111 of 1998; Rule No. 86 of 2004; and Rule No. 40 of 2020)

Article 44-17 In addition to the provisions in this Chapter, provisions pertaining to graduate students shall apply mutatis mutandis to Special Auditing Students and Special Research Students.

Chapter X International Students

(Added on Jul. 1, 1954. Former Chapter IX moved down on Dec. 15, 1960)

Article 45 (1) In cases where a foreign national applies for admission, readmission, or a transfer admission to the Tohoku University Graduate Schools, the admission, readmission, or transfer admission of such foreign national may be permitted as an international student.

(2) For a person who applies for admission, readmission, or transfer admission to the Tohoku University Graduate Schools as an international student, each graduate school may hold special selection processes if it finds special circumstances.

(3) International students may not be included in quotas in certain cases.

(Added on Jul. 1, 1954. Partially revised on/by Jan. 1, 1955; Apr. 1, 1958; Rule No. 26 of 1969; Rule No. 42 of 1973; Rule No. 86 of 2004; Rule No. 85 of 2012; and Rule No. 54 of 2018)

Article 46 No application fee, admission fee, or tuition shall be collected with regard to government-financed or sponsored foreign students based on the Implementation Guideline for the Government-Financed or Sponsored Foreign Student System (Ruling by the Minister of Education, Science and Culture, dated March 31, 1954; hereinafter referred to as the "Implementation Guideline"), notwithstanding the provisions of Article 18 (1), Article 19 (1), and Article 39 (1), respectively (except for application fees and admission fees associated with persons selected as government-financed or sponsored foreign students in accordance with the provision of Article 3 of the Implementation Guideline, on the basis of recommendations made by the recommendation method prescribed in Article 4, Item 4 of the Implementation Guideline).

(Added by Rule No. 42 of 1973. Partially revised by Rule No. 32 of 1975; Rule No. 40 of 1978; Rule No. 7 of 1979; Rule No. 86 of 2004; and Rule No. 66 of 2008)

Article 46-2 No application fee, admission fee, or tuition shall be collected with regard to international students based on university-level exchange agreements that aim to realize joint education between the Tohoku University Graduate Schools and Foreign Graduate Schools, etc., notwithstanding the provisions of Article 18 (1), Article 19 (1), and Article 39 (1), respectively.

Chapter XI Internet School

(Added by Rule No. 284 of 2004)

Article 47 (1) The Internet School of Tohoku University shall be established under the Tohoku University Graduate Schools for the purpose of providing distance learning by utilizing the Internet.

(2) The Internet School of Tohoku University shall be prescribed separately.

Supplementary Provision

These General Rules shall come into force on November 16, 1953, and apply on and after April 1, 1953.

Supplementary Provision (Revised on April 27, 1954)

These General Rules shall come into force on April 27, 1954, and apply on and after April 1, 1954.

Supplementary Provision (Revised on July 1, 1954)

These General Rules shall come into force on July 1, 1954.

Supplementary Provision (Revised on January 1, 1955)

These General Rules shall come into force on January 1, 1955.

Supplementary Provision (Revised on July 1, 1955)

These General Rules shall come into force on July 1, 1955, and apply on and after April 1, 1955; provided, however, that the provision of Article 41 (3) shall apply to the deferment of payment for the second semester in academic year 1955, and for subsequent semesters in subsequent academic years.

Supplementary Provisions (Revised on April 1, 1956)

1. These General Rules shall come into force on April 1, 1956.
2. Notwithstanding these General Rules, the tuition of persons who were admitted to, or who transferred to, the Tohoku University Graduate School during or before academic year 1955 shall continue to conform to the former General Rules.

Supplementary Provision (Revised on July 21, 1956)

These General Rules shall come into force on July 21, 1956.

Supplementary Provision (Revised on March 26, 1957)

These General Rules shall come into force on April 1, 1957.

Supplementary Provision (Revised on April 1, 1958)

These General Rules shall come into force on April 1, 1958.

Supplementary Provision (Revised on July 23, 1958)

These General Rules shall come into force on July 23, 1958, and apply on and after April 1, 1958.

Supplementary Provision (Revised on December 15, 1960)

These General Rules shall come into force on October 1, 1960; provided, however, that the revised provision of the proviso of Article 34 (3) shall apply to persons proceeding to doctoral courses in academic year 1961 or later.

Supplementary Provision (Revised on May 23, 1961)

These General Rules shall come into force on May 23, 1961, and apply on and after April 1, 1961.

Supplementary Provisions (Revision: May 15, 1963, Rule No. 45)

1. These General Rules shall come into force on May 15, 1963, and apply on and after April 1, 1963.
2. Notwithstanding these General Rules, the amount of tuition for graduate students actually enrolled in the Tohoku University Graduate Schools at the time of enforcement of these General Rules shall continue to conform to the former General Rules.
3. Notwithstanding these General Rules, the amount of tuition for graduate auditing students actually enrolled in the Tohoku University Graduate Schools at the time of enforcement of these General Rules shall continue to conform to the former General Rules until their prescribed terms of study expire (except where the term of study is extended, and the beginning of such extension is on or after April 1, 1963).

Supplementary Provision (Revision: March 15, 1966, Rule No. 20)

These General Rules shall come into force on April 1, 1966; provided, however, that the revised amount of the admission application fee shall apply to persons who are to be admitted or readmitted to, or who are to transfer to, the Tohoku University

Graduate Schools in academic year 1967 or later.

Supplementary Provision (Revision: March 18, 1969, Rule No. 26)

These General Rules shall come into force on April 1, 1969.

Supplementary Provision (Revision: March 20, 1971, Rule No. 21)

These General Rules shall come into force on April 1, 1971.

Supplementary Provisions (Revision: April 18, 1972, Rule No. 39)

1. These General Rules shall come into force on April 18, 1972, and apply on and after April 1, 1972.
2. Notwithstanding the revised provision of Article 39, the amount of tuition for graduate students who have continuously been enrolled in the Tohoku University Graduate Schools since prior to April 1, 1972 shall continue to conform to the provision then in force.
3. Notwithstanding the revised provision of Article 39, the amount of tuition for a person who is readmitted, or who transfers, to the Tohoku University Graduate Schools on or after April 1, 1972 shall be the same amount as that for other students in the same year of study as the person concerned.
4. Notwithstanding the revised provision of Article 39, the amount of tuition in academic year 1972 to be collected from graduate students who are admitted to the Tohoku University Graduate Schools in the same academic year shall be 27,000 yen, which shall consist of 9,000 yen for the first semester, and 18,000 yen for the second semester.
5. Notwithstanding the revised provision of Article 44-8, the amount of tuition for graduate auditing students who have continuously been enrolled in the Tohoku University Graduate Schools since prior to April 1, 1972 shall continue to conform to the provision then in force until their prescribed terms of study expire (except where the term of study is extended and the beginning of such extended term is on or after April 1, 1972).
6. Notwithstanding the revised provision of Article 44-8, the amount of tuition for a credit in academic year 1972 to be collected from graduate auditing students who are admitted to the Tohoku University Graduate Schools in the same academic year (including those who have continuously been enrolled in the Tohoku University Graduate Schools since prior to April 1, 1972, and whose prescribed terms of study are extended with the start of such extended terms being on or after April 1, 1972) shall be 600 yen for the first semester, and 1,200 yen for the second semester; provided, however, that the amount of tuition for a credit of a course subject that requires studying through both the first and second semesters in order to acquire the credit shall be the amount obtained by adding half of the amount of tuition for a credit in the first semester and half of the amount of tuition for a credit in the second semester.
7. Notwithstanding the revised provisions of Article 19 (1), and Article 44-7, the amount of the admission fee to be collected from a person whose admission to the Tohoku University Graduate Schools in academic year 1972 is permitted shall continue to conform to the former provisions.
8. Notwithstanding the revised provisions of Article 18 and Article 44-6, the amount of the admission application fee for admission, readmission, or transfer admission in academic year 1972 shall continue to conform to the former provisions.

Supplementary Provision (Revision: October 17, 1972, Rule No. 94)

These General Rules shall come into force on October 17, 1972, and provisions pertaining to study abroad in Articles 31-2 and 31-3 after revision by these General Rules shall apply on and after April 1, 1972.

Supplementary Provision (Revision: May 15, 1973, Rule No. 42)

These General Rules shall come into force on May 15, 1973, and the provision of Article 8 (1) after revision by these General Rules shall apply on and after April 12, 1973.

Supplementary Provisions (Revision: March 18, 1975, Rule No. 9)

1. These General Rules shall come into force on April 1, 1975.
2. Persons who were actually enrolled in master's courses or doctoral courses other than the master's courses of Business Management at the Graduate School of Economics and Management, and Pharmaceutical Technology at the Graduate School of Pharmaceutical Sciences, as of March 31, 1975, and who are to continue to be enrolled in such courses on and after April 1 of the same year shall be students of their respective first two-year master courses or their respective latter three-year doctoral year courses, after the enforcement of these General Rules.
3. With regard to a person who becomes a student of a first two-year master course or latter three-year doctoral course pursuant to the provision of the preceding Supplementary Provision 2., his/her term of study in his/her former master's course or doctoral course in accordance with the former General Rules shall be deemed as his/her term of study in the first two-year course or latter three-year course, and transitional measures pertaining to course subjects, credits, guidance on academic

dissertation preparation, etc., and other relevant matters shall be as prescribed by each graduate school.

Supplementary Provision (Revision: April 1, 1975, Rule No. 32)

These General Rules shall come into force on April 1, 1975.

Supplementary Provision (Revision: October 21, 1975, Rule No. 57)

These General Rules shall come into force on October 21, 1975.

Supplementary Provisions (Revision: April 20, 1976, Rule No. 36)

1. These General Rules shall come into force on April 20, 1976, and apply on and after April 1, 1976.
2. Persons who have been enrolled in the master's course of Economics of the Graduate School of Economics and Management, or Pharmaceutical Chemistry of the Graduate School of Pharmaceutical Sciences prior to April 1, 1976 shall be students of their respective first two-year courses after the enforcement of these General Rules.
3. With regard to a person who becomes a student of one of the first two-year courses pursuant to the provision of the preceding Supplementary Provision 2., his/her term of study in his/her former master's course shall be deemed as his/her term of study in the first two-year course, and the course subjects, credits, and guidance on academic dissertation preparation, etc. that he/she received in his/her master's course shall be deemed as those received in the first two-year course.

Supplementary Provision (Revision: March 15, 1977, Rule No. 17)

These General Rules shall come into force on March 15, 1977.

Supplementary Provision (Revision: May 16, 1978, Rule No. 40)

These General Rules shall come into force on May 16, 1978.

Supplementary Provisions (Revision: January 16, 1979, Rule No. 7)

1. These General Rules shall come into force on January 16, 1979.
2. About persons who are enrolled in the doctoral courses offered by the Graduate School of Medicine or the Graduate School of Dentistry at the time of enforcement of these General Rules, transitional measures pertaining to their course subjects, credits, guidance on academic dissertation preparation, etc., and other relevant matters shall be as prescribed by each of the graduate schools.

Supplementary Provision (Revision: March 17, 1987, Rule No. 13)

These General Rules shall come into force on March 17, 1987.

Supplementary Provision (Revision: February 20, 1990, Rule No. 7)

These General Rules shall come into force on April 1, 1990.

Supplementary Provision (Revision: February 19, 1991, Rule No. 8)

These General Rules shall come into force on February 19, 1991.

Supplementary Provision (Revision: July 16, 1991, Rule No. 53)

These General Rules shall come into force on July 16, 1991, and the revised provisions of Articles 36 and 37 shall apply on and after July 10, 1991.

Supplementary Provision (Revision: September 17, 1991, Rule No. 59)

These General Rules shall come into force on September 17, 1991.

Supplementary Provision (Revision: June 15, 1992, Rule No. 48)

These General Rules shall come into force on June 15, 1992, and apply on and after April 1, 1992.

Supplementary Provision (Revision: April 1, 1993, Rule No. 64)

These General Rules shall come into force on April 1, 1993.

Supplementary Provisions (Revision: April 1, 1994, Rule No. 21)

1. These General Rules shall come into force on April 1, 1994.
2. Notwithstanding these General Rules, the handling of persons who were actually enrolled in the Tohoku University Graduate Schools as auditing students as of March 31, 1994, and are to be continuously enrolled therein on and after April 1, 1994 shall continue to conform to the former General Rules.

Supplementary Provision (Revision: September 20, 1994, Rule No. 79)

These General Rules shall come into force on September 20, 1994.

Supplementary Provision (Revision: March 20, 1995, Rule No. 33)

These General Rules shall come into force on April 1, 1995.

Supplementary Provision (Revision: March 19, 1996, Rule No. 31)

These General Rules shall come into force on April 1, 1996.

Supplementary Provisions (Revision: May 21, 1996, Rule No. 79)
1. These General Rules shall come into force on May 21, 1996.
2. The revised provision of Article 19-2 (1) shall apply to persons for whom admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission in academic year 1996 or later is permitted.
Supplementary Provision (Revision: January 21, 1997, Rule No. 5)
These General Rules shall come into force on April 1, 1997.
Supplementary Provision (Revision: April 21, 1998, Rule No. 111)
These General Rules shall come into force on April 21, 1998.
Supplementary Provision (Revision: October 19, 1999, Rule No. 86)
These General Rules shall come into force on October 19, 1999.
Supplementary Provision (Revision: December 21, 1999, Rule No. 90)
These General Rules shall come into force on April 1, 2000.
Supplementary Provisions (Revision: March 21, 2000, Rule No. 29)
1. These General Rules shall come into force on April 1, 2000.
2. The revised provision of Article 34 (3) shall apply to persons who proceed or transfer to latter three-year doctoral courses, or who enroll in the Medical Course or Dental Course, on or after April 1, 2001.
(Partial revision to the Detailed Rules for Tohoku University Graduate School General Rules)
3. Part of the Detailed Rules for Tohoku University Graduate School General Rules (established on April 27, 1954) shall be revised as follows.
[As follows] Omitted
Supplementary Provision (Revision: February 20, 2001, Rule No. 8)
These General Rules shall come into force on April 1, 2001, and the revised provisions of Article 11 (iv), Article 12 (iii), and Article 15 (iii) shall apply on and after January 6, 2001.
Supplementary Provision (Revision: June 19, 2001, Rule No. 146)
These General Rules shall come into force on June 19, 2001.
Supplementary Provision (Revision: October 16, 2001, Rule No. 158)
These General Rules shall come into force on October 16, 2001.
Supplementary Provision (Revision: April 1, 2002, Rule No. 34)
These General Rules shall come into force on April 1, 2002.
Supplementary Provision (Revision: April 1, 2003, Rule No. 8)
These General Rules shall come into force on April 1, 2003, and the revised provisions of Article 19, Article 19-2, and Article 27 (iii) shall apply to persons for whom admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission in academic year 2003 or later is permitted.
Supplementary Provision (Revision: October 14, 2003, Rule No. 169)
These General Rules shall come into force on October 14, 2003.
Supplementary Provisions (Revision: April 1, 2004, Rule No. 86)
1. These General Rules shall come into force on April 1, 2004.
2. Notwithstanding the revised provision of Article 2, the following majors shall survive until the day on which persons enrolled in such majors as of March 31, 1997 cease to be enrolled in such majors: Japanese Literature and History of Japanese Thought, Japanese Linguistics, English Literature and Linguistics, German Literature and Linguistics, French Literature and Linguistics, Philosophy, Practical Philosophy, Sociology, Psychology, Aesthetics and Art History, Indology and History of Indian Buddhism, Sinology, Japanese History, East Asian History, and Western History offered by the Graduate School of Arts and Letters; Physiology, Pathology, and Social Medicine offered by the Graduate School of Medicine; Material Processing offered by the Graduate School of Engineering; and Fishery Science offered by the Graduate School of Agricultural Science.
3. Notwithstanding the revised provision of Article 2, the major of Internal Medicine offered by the Graduate School of Medicine, and the majors of Animal Husbandry, Agricultural Chemistry, and Food Chemistry offered by the Graduate School of Agricultural Science shall survive until the day on which persons enrolled in these majors as of March 31, 1998 cease to be enrolled in the majors.
4. Notwithstanding the revised provision of Article 2, the majors of Surgery, and Pathological Science offered by the Graduate

School of Medicine, and the majors of Pharmaceutical Science, Pharmaceutical Technology, and Molecular and Pharmaceutical Life Science offered by the Graduate School of Pharmaceutical Sciences shall survive until the day on which persons enrolled in these majors as of March 31, 1999 cease to be enrolled in the majors.

5. Notwithstanding the revised provision of Article 2, the majors of Educational Science, and Educational Psychology offered by the Graduate School of Education, and the majors of Basic Dental Science, and Clinical Dental Science offered by the Graduate School of Dentistry shall survive until the day on which persons enrolled in these majors as of March 31, 2000 cease to be enrolled in the majors.
6. Notwithstanding the revised provision of Article 2, the major of Biology of the Graduate School of Science shall survive until the day on which persons enrolled in the major as of March 31, 2001 cease to be enrolled in the major.
7. Notwithstanding the revised provision of Article 2, the majors of Geoengineering, and Materials Chemistry offered by the Graduate School of Engineering, and the majors of Biological Resource Science, Applied Life Sciences, Resource and Environment Economics, and Environmental Bioremediation offered by the Graduate School of Agricultural Science shall survive until the day on which persons enrolled in these majors as of March 31, 2003 cease to be enrolled in the majors.
8. Notwithstanding the revised provision of Article 2, the majors of Law and Society, and Public Law and Policy offered by the Graduate School of Law, and the majors of Mechanical Engineering and Intelligent Systems, Electronics and Mechanical Engineering, Biochemistry and Engineering, Metallurgy, Materials Science, and Materials Processing offered by the Graduate School of Engineering shall survive until the day on which persons enrolled in these majors as of March 31, 2004 cease to be enrolled in the majors.
9. Notwithstanding the provision of Article 39 (1), the amount of tuition for persons who were enrolled in the Tohoku University Graduate Schools as of March 31, 1999 (hereinafter referred to as an "Enrolled Person"), and those who were readmitted, or who transferred, to the Tohoku University Graduate Schools and entered the same years of study as those of Enrolled Persons on or after April 1, 1999 shall be the amount of tuition applicable as of the day prior to the day of enforcement of these General Rules pursuant to the Ministerial Ordinance Concerning National School Tuition and Other Costs (Ordinance of the Ministry of Education, Science and Culture No. 9 of 1961).

Supplementary Provision (Revision: October 19, 2004, Rule No. 284)

These General Rules shall come into force on October 19, 2004, and the revised provision of Article 47 shall apply on and after October 1, 2004.

Supplementary Provisions (Revision: April 1, 2005, Rule No. 31)

1. These General Rules shall come into force on April 1, 2005.
2. Notwithstanding the revised provision of Article 2, the majors of Economics, Business Management, and Modern Applied Economics Sciences offered by the Graduate School of Economics and Management shall survive until the day on which persons enrolled in the majors as of March 31, 2005 cease to be enrolled in the majors.
3. Notwithstanding the revised provision of Appended Table 2, the amount of tuition for persons who were enrolled in the Tohoku University Graduate Schools as of March 31, 1999 shall be the amount applicable pursuant to the Ministerial Ordinance Concerning National School Tuition and Other Costs (Ordinance of the Ministry of Education, Science and Culture No. 11 of 1964) before its abolition by the Ministerial Ordinance Concerning the Organization of Ministerial Ordinances Relating to the Ministry of Education, Culture, Sports, Science and Technology Following the Enforcement of the National University Corporation Act, etc. (Ordinance of the Ministry of Education, Culture, Sports, Science and Technology No. 15 of 2004).

Supplementary Provision (Revision: September 26, 2005, Rule No. 170)

These General Rules shall come into force on October 1, 2005.

Supplementary Provisions (Revision: April 1, 2006, Rule No. 60)

1. These General Rules shall come into force on April 1, 2006.
2. Notwithstanding the revised provision of Article 2, the major of Transnational Law and Policy offered by the Graduate School of Law shall survive until the day on which persons enrolled in the major as of March 31, 2006 cease to be enrolled in the major.

Supplementary Provision (Revision: July 26, 2006, Rule No. 123)

These General Rules shall come into force on July 26, 2006, and the revised provisions of Article 44-15 (1) (ii) and Article 46-2 shall apply to persons whose acceptance as Special Auditing Students or Special Research Students is permitted, or whose admission or transfer admission as international students is permitted, on or after the date.

Supplementary Provision (Revision: December 22, 2006, Rule No. 178)
These General Rules shall come into force on April 1, 2007.
Supplementary Provision (Revision: March 29, 2007, Rule No. 33)
These General Rules shall come into force on April 1, 2007.
Supplementary Provision (Revision: March 31, 2008, Rule No. 66)
These General Rules shall come into force on April 1, 2008, and the revised provisions of Article 11 (ii) and (ix), Article 12 (vii), and Article 16 (1) (ii) shall apply on and after December 26, 2007.
Supplementary Provision (Revision: March 30, 2009, Rule No. 55)
These General Rules shall come into force on April 1, 2009.
Supplementary Provisions (Revision: March 30, 2010, Rule No. 32)
1. These General Rules shall come into force on April 1, 2010.
2. Notwithstanding the revised provisions of Article 3-2 (1) and (4), and the column of the Graduate School of Pharmaceutical Sciences in Appended Table 1, the doctoral courses of Pharmaceutical Chemistry, Bio-Pharmaceutical Science, and Life Science, which are Partitioned Courses, offered by the Graduate School of Pharmaceutical Sciences shall survive until the day on which persons enrolled in these courses as of March 31, 2010 cease to be enrolled in the courses.
3. Notwithstanding the revised provision of Article 36 (2), the titles of the major fields to be appended to the degrees of persons who enrolled in the First Phase Courses of Pharmaceutical Chemistry, Bio-Pharmaceutical Science, and Life Science of the Graduate School of Pharmaceutical Sciences in or prior to academic year 2009 shall continue to conform to the provision then in force.

Supplementary Provision (Revision: December 7, 2010, Rule No. 97)
These General Rules shall come into force on December 7, 2010.
Supplementary Provision (Revision: March 31, 2011, Rule No. 40)
These General Rules shall come into force on April 1, 2011.
Supplementary Provisions (Revision: March 26, 2012, Rule No. 31)
1. These General Rules shall come into force on April 1, 2012.
2. Notwithstanding the revised provisions of Article 2, and Article 3-2 (4), the Latter Phase Courses of Pharmaceutical Chemistry, Bio-Pharmaceutical Science, and Life Science offered by the Graduate School of Pharmaceutical Sciences shall survive until the day on which persons enrolled in these courses as of March 31, 2012 cease to be enrolled in the courses.
3. Notwithstanding the revised provision of Article 2, the major of Electrical and Communication Engineering of the Graduate School of Engineering shall survive until the day on which persons enrolled in the major as of March 31, 2012 cease to be enrolled in the major.
4. Notwithstanding the revised provisions of Article 33-2 (1) and Article 36 (3), for persons who proceeded or transferred to the Latter Phase Courses of Pharmaceutical Chemistry, Bio-Pharmaceutical Science, and LifeScience offered by the Graduate School of Pharmaceutical Sciences in or prior to academic year 2011, the requirements for completion of their doctoral courses, and the titles of the major fields to be appended to their degrees, shall continue to conform to the provisions then in force.

Supplementary Provision (Revision: June 25, 2012, Rule No. 85)
These General Rules shall come into force on June 25, 2012; provided, however, that the revising provision to delete Article 45 (3) and (4) shall come into force on July 9, 2012.
Supplementary Provision (Revision: March 26, 2013, Rule No. 23)
These General Rules shall come into force on April 1, 2013.
Supplementary Provision (Revision: June 25, 2013, Rule No. 90)
These General Rules shall come into force on June 25, 2013.
Supplementary Provision (Revision: March 25, 2014, Rule No. 34)
These General Rules shall come into force on April 1, 2014, and the revised provision of Article 20 (2) shall apply to screenings for admission, readmission, and transfer admission in academic year 2015 and later.
Supplementary Provisions (Revision: April 10, 2015, Rule No. 65)
1. These General Rules shall come into force on April 10, 2015, and the revised provisions of Article 2 (1), Article 16-2 (5), Article 36 (2), and Appended Table 1 shall apply on and after April 1, 2015.
2. Notwithstanding the revised provision of Article 2, the majors of Area Studies, Intercultural Relations, and Language

Studies offered by the Graduate School of International Cultural Studies, and the major of Environmental Studies offered by the Graduate School of Environmental Studies shall survive until the day on which persons enrolled in these majors as of March 31, 2015 cease to be enrolled in the majors.

Supplementary Provisions (Revision: March 30, 2016, Rule No. 55)

1. These General Rules shall come into force on April 1, 2016.
2. Notwithstanding the revised provision of Article 2, the majors of Mechanical Systems and Design, Nano mechanics, and Bioengineering and Robot Systems offered by the Graduate School of Engineering shall survive until the day on which persons enrolled in the majors as of March 31, 2016 cease to be enrolled in the majors.

Supplementary Provision (Revision: November 22, 2016, Rule No. 80)

These General Rules shall come into force on November 22, 2016.

Supplementary Provision (Revision: March 28, 2017, Rule No. 38)

These General Rules shall come into force on April 1, 2017.

Supplementary Provisions (Revision: March 29, 2018, Rule No. 54)

1. These General Rules shall come into force on April 1, 2018.
2. Notwithstanding the revised provision of Article 2, the majors of Educational Design and Measurement offered by the Graduate School of Education, the majors of Biomolecular Sciences, Developmental Biology and Neurosciences, and Environmental Life Sciences offered by the Graduate School of Life Sciences, and the Graduate School of Educational Informatics Education Division and the major of Educational Informatics offered by the Graduate School of Educational Informatics Research Division and Education Division shall survive until the day on which persons enrolled in these majors as of March 31, 2018 cease to be enrolled in the majors.
3. Provisions pertaining to the Graduate School of Educational Informatics Education Division, which is to continue to survive pursuant to the provision of the preceding Supplementary Provision 2, in the Tohoku University Graduate School General Rules (established on November 26, 1953) before revision by these General Rules shall remain effective until the Graduate School of Educational Informatics Education Division ceases to exist.
4. Notwithstanding the revised provisions of Article 36 (2) and (3), the titles of major fields to be appended to the degrees of persons who were admitted, or who proceeded or transferred, to the Graduate School of Education, or the Graduate School of Educational Informatics Education Division in or prior to academic year 2017 shall continue to conform to the provisions then in force.

Supplementary Provisions (Revision: March 28, 2019, Rule No. 60)

1. These General Rules shall come into force on April 1, 2019.
2. Notwithstanding the revised provision of Article 2, the majors of Humane Studies, Linguistic Studies, Historical Studies, and Human Sciences offered by the Graduate School of Arts and Letters shall survive until the day on which persons enrolled in the majors as of March 31, 2019 cease to be enrolled in the majors.

Supplementary Provision (Revision: March 28, 2020, Rule No. 40)

These General Rules shall come into force on April 1, 2020.

Supplementary Provisions (Amended by Regulation No. 18 of March 28, 2021)

These General Rules shall come into effect as of April 1, 2021.

Supplementary Provisions

1These General Rules shall come into effect as of April 1, 2022.

2Notwithstanding the provisions of Article 2 after the revision, the Division of Natural Resources and Biological Sciences, the Division of Applied Life Sciences, and the Division of Biological and Industrial Innovation Sciences of the Graduate School of Agricultural Science shall come into effect as of March 1, 2022. Notwithstanding the provisions of Article 2 after the revision, the Department of Natural Resources and Biological Sciences, the Department of Applied Life Sciences, and the Department of Biological and Industrial Bioscience of the Graduate School of Agricultural Science shall continue to exist until March 31, 2022, when the students enrolled in those departments cease to be enrolled in those departments.

Article 5-2Supplementary Provisions (Amendment No. 1 of January 27, 2023)

This general rule will come into effect on April 1, 2023.

Appended Table 1 (Related to Articles 2 and 3)

Graduate school	Major	Total admission capacity		New enrollment quota		Course
		First Phase Course, etc.	Latter Phase Course	First Phase Course, etc.	Latter Phase Course	
		No. of persons	No. of persons	No. of persons	No. of persons	
Graduate School of Arts and Letters	Japanese Studies	58	42	29	14	Doctoral course
	Global Humanities	58	36	29	12	Doctoral course
	Integrated Human Sciences	62	36	31	12	Doctoral course
Graduate School of Education	Educational Science	90	45	45	15	Doctoral course
Graduate School of Law	Law and Society	150		50		Professional degree program
	Public Law and Policy	60		30		Professional degree program
	Legal and Political Studies	20	36	10	12	Doctoral course
Graduate School of Economics and Management	Economics and Management	120	42	60	14	Doctoral course
	Accountancy	80		40		Professional degree program
Graduate School of Science	Mathematics	76	54	38	18	Doctoral course
	Physics	182	138	91	46	Doctoral course
	Astronomy	18	12	9	4	Doctoral course
	Geophysics	52	39	26	13	Doctoral course
	Chemistry	132	99	66	33	Doctoral course
	Earth Science	64	48	32	16	Doctoral course
Graduate School of Medicine	Medical Sciences	60	-	30	-	Master's course
		520		130		Doctoral course
	Disability Sciences	40	27	20	9	Doctoral course
	Health Sciences	64	36	32	12	Doctoral course
	Public Health	20	-	10	-	Master's course
Graduate School of Dentistry	Dental Sciences	16	-	8	-	Master's course
		168		42		Doctoral course
Graduate School of Pharmaceutical Sciences	Molecular Pharmaceutical Science	44	24	22	8	Doctoral course
	Life and Pharmaceutical Science	64	30	32	10	Doctoral course
	Pharmacy	16		4		Doctoral course

	Chemical Engineering	68	21	34	7	Doctoral course
	Biomolecular Engineering	38	15	19	5	Doctoral course
	Metallurgy	52	21	26	7	Doctoral course
	Materials Science	74	30	37	10	Doctoral course
	Materials Processing	60	24	30	8	Doctoral course
	Civil and Environmental Engineering	98	36	49	12	Doctoral course
	Architecture and Building Science	90	24	45	8	Doctoral course
	Management Science and Technology	42	39	21	13	Doctoral course
Graduate School of Agricultural Science	Agricultural Bioscience	162	69	81	23	Doctoral course
	Agricultural Chemistry	88	42	44	14	Doctoral course
Graduate School of International Cultural Studies	International Cultural Studies	70	48	35	16	Doctoral course
Graduate School of Information Sciences	Computer and Mathematical Sciences	80	33	40	11	Doctoral course
	System Information Sciences	106	33	53	11	Doctoral course
	Human-Social Information Sciences	60	30	30	10	Doctoral course
	Applied Information Sciences	94	30	47	10	Doctoral course
Graduate School of Life Sciences	Integrative Life Sciences	72	30	36	10	Doctoral course
	Ecological Developmental Adaptability Life Sciences	70	30	35	10	Doctoral course
	Molecular and Chemical Life Sciences	70	30	35	10	Doctoral course
Graduate School of Environmental Studies	Environmental Studies for Advanced Society	80	39	40	13	Doctoral course
	Frontier Science for Advanced Environment	120	60	60	20	Doctoral course
Graduate School of Biomedical Engineering	Biomedical Engineering	78	36	39	12	Doctoral course

Appended Table 2 (Relating to Articles 18, 19, 39, 44-6, 44-7, 44-8, 44-16)

Category		Application fee	Admission fee	Tuition
		Yen	Yen	Yen
Graduate student	Law School course	30,000	282,000	804,000
	Professional degree program in Accountancy from the Graduate School of Economics and Management	30,000	282,000	589,300
	Other courses	30,000	282,000	535,800
Credited Auditor		9,800	28,200	14,800
Special Auditing Student		-	-	14,800
Special Research Student		-	-	29,700

Note

1. With regard to the amount of the application fee for the screenings prescribed in Article 20 (2), the amount for the First Stage Screening shall be 7,000 yen, and that for the Second Stage Screening shall be 23,000 yen.

2. The shown tuition for graduate students is the annual amount.

3. The shown tuition for Credited Auditors and Special Auditing Students is the amount for classes for a credit.

4. The shown tuition for Special Research Students is the monthly amount.

Detailed Rules for Tohoku University Graduate School General Rules

Revised: January 1, 1955
Rule No. 55 of March 29, 20

Article 1 (1) Permission for admission, readmission, progression, transfer admission, or a graduate school transfer shall be given by the President of Tohoku University on the basis of application by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting or Graduate School Committee (hereinafter referred to as the "Faculty Meeting, etc.").

(2) Permission for a major transfer shall be given by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(Partially revised on/by Jan. 1, 1955; Apr. 1, 1958; Jul. 23, 1958; Rule No. 46 of 1963; Rule No. 65 of 1993; Rule No. 2 of 1996; Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 35 of 2002; and Rule No. 55 of 2018)

Article 1-2 (1) The revocation of permission for admission, readmission, progression, transfer admission, or a graduate school transfer shall be executed by the dean of each graduate school upon obtaining the approval of the President of Tohoku University. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(2) The revocation of permission for a major transfer shall be executed by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(Added on May 28, 1955. Partially revised on/by Apr. 1, 1958; Jul. 23, 1958; Rule No. 46 of 1963; Rule No. 65 of 1993; Rule No. 2 of 1996; Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 35 of 2002; and Rule No. 55 of 2018)

Article 2 (1) Permission for a leave of absence or return to study shall be given by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(2) An order to take a leave of absence or return to study shall be issued by the dean of each graduate school upon obtaining the approval of the President of Tohoku University. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(Partially revised on/by Jan. 1, 1955; May 28, 1955; Rule No. 46 of 1963; Rule No. 65 of 1993; Rule No. 2 of 1996; Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 35 of 2002; and Rule No. 55 of 2018)

Article 3 Permission for a transfer to another university or withdrawal from Tohoku University shall be given by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(Partially revised on/by Jan. 1, 1955; Rule No. 46 of 1963; Rule No. 65 of 1993; Rule No. 2 of 1996; Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 35 of 2002; and Rule No. 55 of 2018)

Article 3-2 Expulsion shall be executed by the dean of each graduate school upon obtaining the approval of the President of Tohoku University. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(Added by Rule No. 2 of 1996. Partially revised by Rule No. 34 of 1996; Rule No. 29 of 2000; No. 35 of 2002; and Rule No. 55 of 2018)

Article 3-3 (1) The dean of each graduate school shall engage in the types of consultation specified in the following items. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.

(i) In relation to study, consultation with other universities' graduate schools or research institutes, etc. (hereinafter referred to as "Other Graduates Schools, etc."), or foreign universities' graduate schools or other institutions of higher education equivalent to such foreign graduate schools (hereinafter referred to as "Foreign Graduate Schools, etc.")

(ii) In relation to study, consultation with educational institutions that are recognized, under the schooling systems of foreign countries, as providers of graduate courses of such foreign countries, and that are separately designated by the Minister of Education, Culture, Sports, Science and Technology, or with the United Nations University, which was founded on the basis of the United Nations General Assembly Resolution of December 11, 1972, as set forth in Article 1, Paragraph 2 of the Act on Special Measures Incidental to Enforcement of the "Agreement between the United Nations and Japan regarding the Headquarters of the United Nations University" (Act No. 72 of 1976) (hereinafter referred to as "Educational Institutions, etc. Providing Foreign Graduate Courses")

(iii) Consultation with Foreign Graduate Schools, etc. in relation to study abroad or study during a leave of absence

(2) Notwithstanding the provision of the preceding Article 3-3 (1), the consultation concerned may be carried out by the

President of Tohoku University on the basis of application by the dean of each graduate school, under special circumstances.
(Added by Rule No. 95 of 1972. Partially revised by Rule No. 10 of 1975; and Rule No. 65 of 1993. Former Article 3-2 moved down and partially revised by Rule No. 2 of 1996. Partially revised by Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 159 of 2001; Rule No. 35 of 2002; Rule No. 220 of 2004; Rule No. 175 of 2005; Rule No. 98 of 2010; and Rule No. 55 of 2018)

Article 3-4 The dean of each graduate school shall give permission to study at Other Graduates Schools, etc., to take course subjects in Japan through corresponding education provided by Foreign Graduate Schools, etc., to take, in Japan, course subjects in the curricula of foreign graduate schools through Educational Institutions, etc. Providing Foreign Graduate Courses, or to study abroad, or study during a leave of absence, at Foreign Graduate Schools, etc. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.
(Added by Rule No. 95 of 1972. Partially revised by Rule No. 10 of 1975; and Rule No. 65 of 1993. Former Article 3-3 moved down and partially revised by Rule No. 2 of 1996. Partially revised by Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 159 of 2001; Rule No. 35 of 2002; Rule No. 220 of 2004; Rule No. 175 of 2005; Rule No. 98 of 2010; and Rule No. 55 of 2018)

Article 4 A master's degree, doctoral degree, or professional degree shall be conferred by the President of Tohoku University on the basis of certification by the dean of each graduate school.
(Partially revised on/by Jan. 1, 1955; Rule No. 46 of 1963; Rule No. 54 of 1991; Rule No. 34 of 1996; Rule No. 35 of 2002; Rule No. 220 of 2004; and Rule No. 55 of 2018)

Article 5 (1) Disciplinary action shall be applied for by the dean of each graduate school to the President of Tohoku University upon deliberation by the Faculty Meeting, etc., and shall be executed by the dean by order of the President.

(2) After having ordered the dean of a graduate school to execute disciplinary action in accordance with the provision of the preceding Article 5 (1), the President of Tohoku University shall report it to the Education and Research Council.
(Partially revised on/by Jan. 1, 1955; Rule No. 46 of 1963; Rule No. 65 of 1993; Rule No. 34 of 1996; Rule No. 29 of 2000; Rule No. 21 of 2001; Rule No. 140 of 2001; Rule No. 35 of 2002; Rule No. 220 of 2004; Rule No. 121 of 2005; and Rule No. 55 of 2018)

Article 6 (1) The lifting of suspension shall be applied for by the dean of each graduate school to the President of Tohoku University upon deliberation by the Faculty Meeting, etc., and shall be executed by the dean by order of the President.

(2) After having ordered the dean of a graduate school to execute the lifting of suspension in accordance with the provision of the preceding Article 6 (1), the President of Tohoku University shall report it to the Education and Research Council.
(Fully revised by Rule No. 46 of 1963; and Rule No. 121 of 2005. Partially revised by Rule No. 55 of 2018)

Article 7 The provisions of Articles 1 to 3-2, Article 5 (1), and Article 6 (1) shall apply mutatis mutandis to Credited Auditors. In this case, "the President of Tohoku University on the basis of application by the dean of each graduate school" in Article (1) shall be replaced with "the dean of each graduate school"; "the dean of each graduate school upon obtaining the approval of the President of Tohoku University" in Article 1-2 (1), Article 2 (2), and Article 3-2 shall be replaced with "the dean of each graduate school"; and "applied for by the dean of each graduate school to the President of Tohoku University upon deliberation by the Faculty Meeting, etc., and shall be executed by the dean by order of the President" in Article 5 (1) and Article 6 (1) shall be replaced with "executed by the dean of each graduate school."
(Fully revised by Rule No. 35 of 2002. Partially revised by Rule No. 121 of 2005; and Rule No. 55 of 2018)

Article 8 Permission for any extension of the term of study of a Credited Auditor, or for any increase or reduction in a Credited Auditor's course subjects shall be given by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.
(Added on Dec. 15, 1960. Partially revised by Rule No. 46 of 1963; Rule No. 65 of 1993; Rule No. 22 of 1994; Rule No. 29 of 2000; Rule No. 35 of 2002; and Rule No. 55 of 2018)

Article 9 Deleted
(Rule No. 2 of 1996)

Article 10 Permission to accept Special Auditing Students or Special Research Students, the revocation of permission for such acceptance, or permission for change in the period of acceptance or for any increase or reduction in Special Auditing Students' course subjects shall be executed by the dean of each graduate school. In this case, such permission shall be subject to deliberation by the Faculty Meeting, etc.
(Added by Rule No. 95 of 1972. Partially revised by Rule No. 10 of 1975; Rule No. 58 of 1975; Rule No. 65 of 1993; Rule

No. 2 of 1996; Rule No. 29 of 2000; Rule No. 35 of 2002; and Rule No. 55 of 2018)

Article 11 The dean of each graduate school shall report to the President of Tohoku University after giving permission pursuant to the provisions of Article 1 (2), Article 2 (1), Article 3, or Article 3-4, revoking permission pursuant to the provision of Article 1-2 (2), or having consultations pursuant to the provision of Article 3-3 (1).

These Detailed Rules shall come into force on April 27, 1954, and apply on and after April 1, 1953.

Supplementary Provision (Revised on January 1, 1955)

These Detailed Rules shall come into force on April 1, 1955.

Supplementary Provision (Revised on May 28, 1955)

These Detailed Rules shall come into force on April 1, 1955.

Supplementary Provision (Revised on April 1, 1958)

These Detailed Rules shall come into force on April 1, 1958.

Supplementary Provision (Revised on July 23, 1958)

These Detailed Rules shall come into force on July 23, 1958, and apply on and after April 1, 1958.

Supplementary Provision (Revised on December 15, 1960)

These Detailed Rules shall come into force on October 1, 1960.

Supplementary Provision (Revision: May 15, 1963, Rule No. 46)

These Detailed Rules shall come into force on May 15, 1963, and apply on and after April 1, 1963.

Supplementary Provision (Revision: October 17, 1972, Rule No. 95)

These Detailed Rules shall come into force on October 17, 1972.

Supplementary Provision (Revision: March 18, 1975, Rule No. 10)

These Detailed Rules shall come into force on April 1, 1975.

Supplementary Provision (Revision: October 21, 1975, Rule No. 58)

These Detailed Rules shall come into force on October 21, 1975.

Supplementary Provision (Revision: July 16, 1991, Rule No. 54)

These Detailed Rules shall come into force on July 16, 1991, and the revised provision of Article 4 shall apply on and after July 10, 1991.

Supplementary Provision (Revision: April 1, 1993, Rule No. 65)

These Detailed Rules shall come into force on April 1, 1993.

Supplementary Provisions (Revision: April 1, 1994, Rule No. 22)

1. These Detailed Rules shall come into force on April 1, 1994.
2. Notwithstanding these Detailed Rules, the handling of persons who were actually enrolled as auditing students as of March 31, 1994, and are to be continuously enrolled on and after April 1, 1994 shall continue to conform to the former Detailed Rules.

Supplementary Provision (Revision: January 16, 1996, Rule No. 2)

These Detailed Rules shall come into force on April 1, 1996.

Supplementary Provision (Revision: March 19, 1996, Rule No. 34)

These Regulations shall come into force on April 1, 1996.

Supplementary Provision (Revision: March 21, 2000, Rule No. 29) Extract

1. These Detailed Rules shall come into force on April 1, 2000.

Supplementary Provision (Revision: March 19, 2001, Rule No. 21)

These Detailed Rules shall come into force on April 1, 2001.

Supplementary Provision (Revision: May 15, 2001, Rule No. 140)

These Detailed Rules shall come into force on May 15, 2001.

Supplementary Provision (Revision: October 16, 2001, Rule No. 159)

These Detailed Rules shall come into force on October 16, 2001.

Supplementary Provision (Revision: April 1, 2002, Rule No. 35)

These Detailed Rules shall come into force on April 1, 2002.

Supplementary Provision (Revision: April 1, 2004, Rule No. 220)

These Detailed Rules shall come into force on April 1, 2004.

Supplementary Provisions (Revision: April 1, 2005, Rule No. 121)

1. These Detailed Rules shall come into force on April 1, 2005.
2. Notwithstanding the revised provisions of Articles 5, 6, and 7, the procedures for disciplinary action actually implemented at the time of enforcement of these Detailed Rules shall continue to conform to the former provisions.

Supplementary Provision (Revision: September 26, 2005, Rule No. 175)

These Detailed Rules shall come into force on October 1, 2005.

Supplementary Provision (Revision: March 27, 2009, Rule No. 50)

These Detailed Rules shall come into force on April 1, 2009.

Supplementary Provision (Revision: December 7, 2010, Rule No. 98)

These Detailed Rules shall come into force on December 7, 2010.

Supplementary Provisions (Revision: March 29, 2018, Rule No. 55)

1. These Detailed Rules shall come into force on April 1, 2018.
2. Provisions pertaining to the Graduate School of Educational Informatics Education Division, which is to continue to survive pursuant to the provision of Supplementary Provision 2 of the Regulations to Partially Revise Tohoku University Graduate School General Rules (Rule No. 54 of 2018), in the Detailed Rules for Tohoku University Graduate School General Rules (established on April 27, 1954) before revision by these Detailed Rules shall remain effective until the Graduate School of Educational Informatics Education Division ceases to exist.

Regulations on Tohoku University Research Students

May 15, 1963
Rule No. 49
Revised: Rule No. 77 of November 26, 2019

Article 1 These Regulations prescribe the admission, types, terms of study, and other relevant details of Research Students at Tohoku University (hereinafter referred to as the "University").

Article 2 In cases where a person applies to conduct research on a special topic at the University, such person may, through selection processes, be permitted to be admitted as a Research Student to a graduate school, an undergraduate school, a research institute, one of the organizations prescribed in Article 20 (1) of the Regulations on Management of Organization at National University Corporation Tohoku University (Rule No. 1 of 2004; hereinafter referred to as the "Regulations on Management of Organization"), one of the research organizations prescribed in Article 20 (3) of the Regulations on Management of Organization, one of the Inter-Department Institutes for Education and Research, etc.
prescribed in Article 21 of the Regulations on Management of Organization, or one of the centers, etc.
prescribed in Articles 22 to 26 of the Regulations on Management of Organization, provided that such admission will not pose any obstacle.

Article 3 Research Students shall be categorized into the following three types.

Undergraduate Research Student: Person who engages in research with a faculty member at the relevant undergraduate or graduate school acting as an Academic Advisor

Research Institute Research Student: Person who engages in research with an Academic Advisor who is a faculty member at a research institute, one of the organizations prescribed in Article 20 (1) of the Regulations on Management of Organization, one of the research organizations prescribed in Article 20 (3) of the Regulations on Management of Organization, one of the Inter-Department Institutes for Education and Research, etc. prescribed in Article 21 of the Regulations on Management of Organization, or one of the centers, etc. prescribed in Articles 22 to 26 of the Regulations on Management of Organization

Graduate Research Student: Person who engages in research with a faculty member at the relevant graduate school acting as an Academic Advisor

Article 4 (1)A year of study for a Research Student shall start from April 1 of a year and end on March 31 of the following year.

(2) A year of study shall be divided into the following two semesters:

First semester: from April 1 to September 30

Second semester: from October 1 to March 31 of the following year

Article 5 The timing of enrollment of a Research Student shall be at the beginning of a semester, unless there are special circumstances.

Article 6 A person who is eligible to apply for admission as an Undergraduate Research Student or Research Institute Research Student shall fall under one of the following items:

(i)A person who graduated from a university.

(ii)A person who graduated from a junior college or a school equivalent to or greater than the same (including those who completed the first phase course of a professional university) and who studied in a relevant department; or

(iii)A person who is found to have academic abilities at least equivalent to those of the persons prescribed in the preceding two items by a graduate school, an undergraduate school, a research institute, one of the organizations prescribed in Article 20 (1) of the Regulations on Management of Organization, one of the research organizations prescribed in Article 20 (3) of the Regulations on Management of Organization, one of the Inter-Department Institutes for Education and Research, etc. prescribed in Article 21 of the Regulations on Management of Organization, or one of the centers, etc. prescribed in Articles 22 to 26 of the Regulations on Management of Organization.

Article 7 (1) A person who is eligible to apply for admission as a Graduate Research Student shall fall under one of the following items:

(i) A person who holds a master's degree.

(ii) A person who graduated from a university course in medicine, dentistry, pharmacy, or veterinary medicine. or

(iii) A person who is found to have academic abilities at least equivalent to those of the persons prescribed in the preceding two items by a graduate school.

(2) In addition to the provision of the preceding Article 7 (1), the eligibility of foreign nationals to apply for admission as Graduate Research Students shall be as prescribed by each Graduate School.

Article 8 (1) A person who applies for admission as a Research Student shall pay an application fee with his/her application form.

(2) The amount of the application fee in the preceding Article 8 (1) shall be as specified in Appended Table.

Article 9 (1) A person whose admission as a Research Student has been permitted shall pay an admission fee by the prescribed due date.

(2) The permission of admission of a person who has failed to pay the admission fee under the preceding Article 9 (1) by the prescribed due date shall be revoked.

(3) The amount of the admission fee in Article 9 (1) shall be as specified in Appended Table.

Article 10 Any paid application fee or admission fee shall not be refunded.

Article 11 The term of study for Research Students shall be up to one year; provided, however, that an extension of the term of study may be permitted, if continued enrollment is requested.

Article 12 (1) In cases where a Graduate Research Student who is a foreign national applies to audit a course subject or more of his/her choice in connection with his/her research among the course subjects offered by the University's graduate schools (including related subjects), such auditing may be permitted through selection processes, provided that such auditing will not obstruct other students' study.

(2) A Graduate Research Student who has been permitted to audit course subjects as prescribed in the preceding Article 12 (1) may acquire credits for the course subjects that such Graduate Research Student has audited, by taking the examinations designated for such course subjects.

(3) A request made by a Graduate Research Student who has been permitted to audit course subjects as prescribed in Article 12 (1) for any increase or reduction in the number of his/her course subjects may be permitted.

Article 13 (1) In cases where a Research Student requests the certification of matters relating to his/her research, a research certificate may be issued.

(2) In cases where a Graduate Research Student who has been permitted to audit course subjects as prescribed in Article 12 (1) requests the certification of the course subjects that he/she has audited, or the credits that he/she has acquired, a certificate of auditing, or a certificate of the acquisition of credits, may be issued.

Article 14 (1) Any Research Student who violates any regulations or orders of the University, or acts contrary to his/her duties as a Research Student, shall be subject to disciplinary action.

(2) The available types of disciplinary action shall be reprimand and expulsion.

Article 15 A Research Student who intends to withdraw from the University during his/her term of study shall apply for permission for such withdrawal with the reason therefor.

Article 16 (1) The monthly amount of tuition for Research Students shall be as specified in Appended Table, which shall be paid in advance for each three months from the month of their admission; provided, however, that in the case of any fractional months less than three months in the year of study, the tuition for such fractional months shall be paid in advance.

(2) Graduate Research Students who have been permitted to audit course subjects as prescribed in Article 12 (1) shall pay the tuition for the course subjects that they are to audit, in addition to the tuition prescribed in the preceding Article 16 (1).

(3) The amount of the tuition prescribed in the preceding Article 16 (2) shall be as specified in Appended Table, for classes equivalent to each credit, and shall be paid in advance for the relevant semester prior to the beginning of classes in each semester.

(4) Paid tuition shall not be refunded.

(5) The amount of tuition to be paid, due dates, places, and other matters necessary for the payment of tuition shall be specified at the designated location.

Article 17 No application fee, admission fee, or tuition shall be collected with regard to government-financed or sponsored foreign students based on the Implementation Guideline for the Government-Financed or Sponsored Foreign Student

System (Ruling by the Minister of Education, Science and Culture, dated March 31, 1954), or international students who are covered by university-level exchange agreements on the basis of the Implementation Guidelines for Non-collection of Tuition, etc. for International Students based on University-level Exchange Agreements (Ruling by the Director of Science and International Affairs Bureau, dated April 11, 1991), notwithstanding the provisions of Article 8, Article 9 (1), and Article 16 ()1 and (3), respectively.

Article 18 A Research Student shall be expelled if he/she failed to pay his/her tuition, and has still failed to pay it even after having received a demand.

Article 19 In addition to the provisions of these Regulations, provisions pertaining to students shall apply mutatis mutandis to Research Students.

Supplementary Provision

1. These Regulations shall come into force on May 15, 1963, and apply on and after April 1, 1963.
2. Research Students actually enrolled in the University at the time of enforcement of these Regulations and based on the former provisions shall be deemed as Research Students admitted on the basis of these Regulations.
3. Notwithstanding these Regulations, the amounts of research fees and tuition to be borne by Research Students based on the provision of the preceding Supplementary Provision 2. shall continue to conform to the former Regulations until their prescribed terms of study expire (except where the term of study is extended and the beginning of such extension is on or after April 1, 1963).

Supplementary Provision (Revision: March 15, 1966, Rule No. 21)

These Regulations shall come into force on April 1, 1966; provided, however, that the revised amount of the admission application fee shall apply to persons who enroll in the University on or after April 1, 1967. provided, however, that the revised amount of the admission application fee shall apply to persons who are to be admitted to the Tohoku University Graduate Schools on April 1, 1967 or later.

Supplementary Provisions (Revision: April 18, 1972, Rule No. 41)

1. These Regulations shall come into force on April 18, 1972, and apply on and after April 1, 1972.
2. Notwithstanding the revised provision of the main text of Article 17 (1), the monthly amount of research fees for persons who have continuously been enrolled in the University since prior to April 1, 1972 shall continue to conform to the provision then in force until their prescribed terms of study expire (except where the term of study is extended, and the beginning of such extended term is on or after April 1, 1972).
3. Notwithstanding the revised provision of the main text of Article 17 (1), the monthly amounts of research fees in academic year 1972 to be collected from persons who are admitted to the University in the same academic year (including those who have continuously been enrolled in the University since prior to April 1, 1972, whose prescribed terms of study are extended, and whose extended terms start on or after April 1, 1972) shall be 800 yen for the first semester, and 2,400 yen for the second semester.
4. Notwithstanding the revised provisions of Article 8 and Article 9 (1), the amount of the admission application fee for admission in academic year 1972, and the amount of the admission fee to be collected from a person whose admission to the University in the same academic year is permitted shall continue to conform to the former provisions.
5. Notwithstanding the revised provision of Article 17 (3), the amounts of tuition for a credit in academic year 1972 to be collected from Graduate Research Students who are foreign nationals and permitted to audit lecture subjects provided by the University's graduate schools in the same academic year shall be 600 yen for the first semester, and 1,200 yen for the second semester; provided, however, that the amount of tuition for a credit for a course subject that requires studying through both the first and second semesters in order to acquire the credit shall be the amount obtained by adding half of the amount of tuition for a credit in the first semester and half of the amount of tuition for a credit in the second semester.

Supplementary Provision (Revision: April 17, 1973, Rule No. 34)

These Regulations shall come into force on April 17, 1973 and apply on and after April 1, 1973.

Supplementary Provision (Revision: July 17, 1973, Rule No. 62)

These Regulations shall come into force on July 17, 1973.

Supplementary Provision (Revision: March 18, 1975, Rule No. 13)

These Regulations shall come into force on April 1, 1975.

Supplementary Provision (Revision: April 1, 1975, Rule No. 33)

These Regulations shall come into force on April 1, 1975.
Supplementary Provision (Revision: November 18, 1980, Rule No. 37)
These Regulations shall come into force on November 18, 1980.
Supplementary Provision (Revision: April 20, 1982, Rule No. 30)
These Regulations shall come into force on April 20, 1982.
Supplementary Provision (Revision: February 21, 1984, Rule No. 7)
These Regulations shall come into force on April 1, 1984.
Supplementary Provision (Revision: March 15, 1988, Rule No. 20)
These Regulations shall come into force on April 1, 1988.
Supplementary Provision (Revision: April 19, 1988, Rule No. 53)
These Regulations shall come into force on April 19, 1988, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 8, 1988.
Supplementary Provision (Revision: February 20, 1990, Rule No. 8)
These Regulations shall come into force on April 1, 1990.
Supplementary Provision (Revision: October 16, 1990, Rule No. 37)
These Regulations shall come into force on April 1, 1991.
Supplementary Provision (Revision: July 16, 1991, Rule No. 56)
These Regulations shall come into force on July 16, 1991.
Supplementary Provisions (Revision: April 1, 1993, Rule No. 68)
1. These Regulations shall come into force on April 1, 1993.
2. The handling of the statuses, etc. of persons who are actually enrolled in the College of General Education as Research Students at the time of enforcement of these Regulations, and are to continue to be enrolled shall continue to conform to the former Regulations until their prescribed terms of study expire.

Supplementary Provision (Revision: March 20, 1995, Rule No. 35)
These Regulations shall come into force on April 1, 1995.
Supplementary Provision (Revision: May 21, 1996, Rule No. 78)
These Regulations shall come into force on May 21, 1996, and the provision of the section of Computer Center in the Appended Table of the Regulations on Official Seals at Tohoku University after revision by the provision of Article 1 hereof shall apply on and after April 1, 1996, and the following provisions shall apply on and after May 11, 1996: the provisions of the table in Article 4 (1), and the Appended Table (except the section of Computer Center), of the Regulations on Official Seals at Tohoku University after revision by the provision of Article 1 hereof; the provision of the table in Article 2 (1) of the Internal Regulations on Handling of Accidents at Tohoku University after revision by the provision of Article 2 hereof; the provision of Article 3 (1) of the Regulations on Health and Safety Management for Employees at Tohoku University after revision by the provision of Article 3 hereof; the provision of Article 3 (iii) of the Regulations on Endowed Chairs and Research Divisions at Tohoku University after revision by the provision of Article 4 hereof; the provision of Article 2 (4) of the Regulations on Joint Research Administration at Tohoku University after revision by the provision of Article 5 hereof; the provision of Article 2 (2) of the Regulations on Commissioned Research Administration at Tohoku University after revision by the provision of Article 6 hereof; the provision of Article 7 (1) (vii) of the Standards for Tohoku University President Selection and Term of Office after revision by the provision of Article 7 hereof; the provisions of Articles 2 and 3, and Article 6 (iii) of the Regulations on Tohoku University Research Students after revision by the provision of Article 8 hereof; the provision of Article 1 (1) of the Detailed Regulations on Tohoku University Research Students after revision by the provision of Article 9 hereof; and the provision of Article 4 (1) of the Regulations on Visiting Scholar Administration at Tohoku University after revision by the provision of Article 10 hereof.
Supplementary Provision (Revision: April 9, 1998, Rule No. 74)
These Regulations shall come into force on April 9, 1998.
Supplementary Provisions (Revision: March 21, 2000, Rule No. 44)
1. These Regulations shall come into force on April 1, 2000.
   (Partial revision to the Detailed Regulations on Tohoku University Research Students)
2. Part of the Detailed Regulations on Tohoku University Research Students (Rule No. 50 of 1963) shall be revised as follows.
   [As follows] Omitted

Supplementary Provision (Revision: February 20, 2001, Rule No. 10)
These Regulations shall come into force on April 1, 2001.
Supplementary Provision (Revision: April 8, 2002, Rule No. 109)
These Regulations shall come into force on April 8, 2002, and the revised provisions of Articles 2 and 3, Article 6 (iii), and Article 7 shall apply on and after April 1, 2002.
Supplementary Provision (Revision: April 1, 2003, Rule No. 32)
These Regulations shall come into force on April 1, 2003.
Supplementary Provision (Revision: April 1, 2004, Rule No. 116)
These Regulations shall come into force on April 1, 2004.
Supplementary Provision (Revision: October 26, 2004, Rule No. 296)
These Regulations shall come into force on October 26, 2004, and the revised provisions of Articles 2, 3, and 6 shall apply on and after October 1, 2004.
Supplementary Provision (Revision: March 31, 2005, Rule No. 30)
These Regulations shall come into force on April 1, 2005.
Supplementary Provision (Revision: May 23, 2006, Rule No. 112)
These Regulations shall come into force on May 23, 2006, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2006.
Supplementary Provision (Revision: April 10, 2007, Rule No. 107)
These Regulations shall come into force on April 10, 2007, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2007.
Supplementary Provision (Revision: March 11, 2008, Rule No. 20)
These Regulations shall come into force on March 11, 2008.
Supplementary Provision (Revision: April 22, 2008, Rule No. 85)
These Regulations shall come into force on April 22, 2008, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2008.
Supplementary Provision (Revision: September 29, 2008, Rule No. 142)
These Regulations shall come into force on October 1, 2008.
Supplementary Provision (Revision: April 14, 2009, Rule No. 64)
These Regulations shall come into force on April 14, 2009, and the revised provisions of Articles 2, 3, and 6 shall apply on and after April 1, 2009.
Supplementary Provision (Revision: December 8, 2009, Rule No. 112)
These Regulations shall come into force on December 8, 2009, and the revised provisions of Articles 2, 3, and 6 shall apply on and after December 1, 2009.
Supplementary Provision (Revision: March 13, 2012, Rule No. 19)
These Regulations shall come into force on April 1, 2012.
Supplementary Provision (Revision: May 8, 2012, Rule No. 53)
These Regulations shall come into force on May 8, 2012, and the revised provisions of Articles 2, 3, and 6 shall apply on and after February 1, 2012.
Supplementary Provision (Revision: June 25, 2012, Rule No. 86)
These Regulations shall come into force on July 9, 2012.
Supplementary Provision (Revision: April 23, 2013, Rule No. 67)
These Regulations shall come into force on April 23, 2013, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2013.
Supplementary Provision (Revision: April 22, 2014, Rule No. 85)
These Regulations shall come into force on April 22, 2014, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2014.
Supplementary Provision (Revision: April 28, 2015, Rule No. 70)
These Regulations shall come into force on April 28, 2015, and apply on and after April 1, 2015.
Supplementary Provision (Revision: April 26, 2016, Rule No. 60)
These Regulations shall come into force on April 26, 2016 [omitted], and apply on and after April 1, 2016.

Supplementary Provision (Revision: April 25, 2017, Rule No. 85)

These Regulations shall come into force on April 25, 2017, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2017.

Supplementary Provision (Revision: May 8, 2018, Rule No. 111)

These Regulations shall come into force on May 8, 2018. The revised provisions of Articles 2 and 3, and Article 6 (iii) (limited to the part changing "or" to ", the part changing "Article 29" to "Article 27", and the part adding "the Advanced Institute for Materials Research, or the Frontier Research Institute for Interdisciplinary Sciences" after "one of the centers, etc. prescribed in Articles 22 to 29 of the Regulations on Management of Organization") shall apply on and after January 30, 2018. The revised provisions of Articles 2 and 3, and Article 6 (iii) (limited to the part deleting ", the Education Division or Research Division"), and the revised provisions of Article 7 shall apply on and after April 1, 2018.

Supplementary Provision (Revision: March 26, 2019, Rule No. 32)

These Regulations shall come into force on April 1, 2019.

Supplementary Provision (Revision: April 23, 2019, Rule No. 73)

These Regulations shall come into force on April 23, 2019, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after April 1, 2019.

Supplementary Provision (Revision: November 26, 2019, Rule No. 77)

These Regulations shall come into force on November 26, 2019, and the revised provisions of Articles 2 and 3, and Article 6 (iii) shall apply on and after October 1, 2019.

Detailed Rules for Regulations on Tohoku University Research Students

(Permission for Admission, Expulsion, etc.)

Article 1 It shall be the duty of the head of each of the following departments (hereinafter referred to as "Department Head") to permit the admission of Research Students, any extension of their terms of study, or their withdrawals, revoke permission for their admission, or expel them, upon deliberation by the Faculty Meeting (in the case where a faculty meeting has not been set up, an organization equivalent thereto; the same shall apply hereinafter) or the Graduate School Committee: graduate schools, undergraduate schools, research institutes, the organizations prescribed in Article 20 (1) of the Regulations on Management of Organization at National University Corporation Tohoku University (Rule No. 1 of 2004; hereinafter referred to as the "Regulations on Management of Organization"), the research organizations prescribed in Article 20 (3) of the Regulations on Management of Organization, the Inter-Department Institutes for Education and Research, etc. prescribed in Article 21 of the Regulations on Management of Organization, or the centers, etc. prescribed in Articles 22 to 26 of the Regulations on Management of Organization.

(Disciplinary Action)

Article 2 It shall be the duty of each Department Head to take disciplinary action upon deliberation by the Faculty Meeting or Graduate School Committee.

(Issuance of a Research Certificate)

Article 3 It shall be the duty of each Department Head to issue a research certificate.

(Permission for Auditing, etc.)

Article 4 It shall be the duty of the dean of each graduate school, upon deliberation by the Faculty Meeting or Graduate School Committee, to permit auditing or any increase or reduction in the number of subjects to be audited.

(Issuance of a Certificate of Auditing, etc.)

Article 5 It shall be the duty of each Graduate School Dean to issue a certificate of auditing, or a certificate of the acquisition of credits.

Supplementary Provision

These Detailed Rules shall come into force on May 15, 1963, and apply on and after April 1, 1963.

Supplementary Provision (Revision: July 17, 1973, Rule No. 63)

These Detailed Rules shall come into force on July 17, 1973.

Supplementary Provision (Revision: November 18, 1980, Rule No. 38)

These Regulations shall come into force on November 18, 1980.

Supplementary Provision (Revision: February 21, 1984, Rule No. 8)

These Detailed Rules shall come into force on April 1, 1984.

Supplementary Provision (Revision: March 15, 1988, Rule No. 21)

These Detailed Rules shall come into force on April 1, 1988.

Supplementary Provision (Revision: April 19, 1988, Rule No. 54)

These Detailed Rules shall come into force on April 19, 1988, and the revised provision of Article 1 (1) shall apply on and after April 8, 1988.

Supplementary Provision (Revision: October 16, 1990, Rule No. 38)

These Detailed Rules shall come into force on April 1, 1991.

Supplementary Provisions (Revision: April 1, 1993, Rule No. 69)

1. These Detailed Rules shall come into force on April 1, 1993.
2. The revised provisions of Article 1 (1) and Article 4 (1) shall apply with "undergraduate school" therein replaced with "undergraduate school and the General Education Department," and "Faculty Meeting" replaced with "Faculty Meeting (or the Instructor Meeting for the General Education Department)," until March 31, 1994.

Supplementary Provision (Revision: March 20, 1995, Rule No. 36)

These Detailed Rules shall come into force on April 1, 1995.

Supplementary Provision (Revision: January 16, 1996, Rule No. 3)
These Detailed Rules shall come into force on April 1, 1996.
Supplementary Provision (Revision: March 19, 1996, Rule No. 34)
These Regulations shall come into force on April 1, 1996.
Supplementary Provision (Revision: May 21, 1996, Rule No. 78)
These Regulations shall come into force on May 21, 1996, and the provision of the section of Computer Center in the Appended Table of the Regulations on Official Seals at Tohoku University after revision by the provision of Article 1 hereof shall apply on and after April 1, 1996, and the following provisions shall apply on and after May 11, 1996: the provisions of the table in Article 4 (1), and the Appended Table (except the section of Computer Center), of the Regulations on Official Seals at Tohoku University after revision by the provision of Article 1 hereof; the provision of the table in Article 2 (1) of the Internal Regulations on Handling of Accidents at Tohoku University after revision by the provision of Article 2 hereof; the provision of Article 3 (1) of the Regulations on Health and Safety Management for Employees at Tohoku University pursuant to the provision of Article 3 hereof; the provision of Article 3 (iii) of the Regulations on Donation Lectures and Endowed Research Division at Tohoku University after revision by the provision of Article 4 hereof; the provision of Article 2 (4) of the Regulations on Collaborative Research Administration at Tohoku University after revision by the provision of Article 5 hereof; the provision of Article 2 (2) of the Regulations on Commissioned Research Administration at Tohoku University after revision by the provision of Article 6 hereof; the provision of Article 7 (1) (vii) of the Standards for Tohoku University President Selection and Term of Office after revision by the provision of Article 7 hereof; the provisions of Articles 2 and 3, and Article 6 (iii) of the Regulations on Tohoku University Research Students after revision by the provision of Article 8 hereof; the provision of Article 1 (1) of the Detailed Rules for Regulations on Tohoku University Research Students after revision by the provision of Article 9 hereof; and the provision of Article 4 (1) of the Regulations on Visiting Scholar Administration at Tohoku University after revision by the provision of Article 10 hereof.
Supplementary Provision (Revision: April 9, 1998, Rule No. 74)
These Regulations shall come into force on April 9, 1998.
Supplementary Provision (Revision: March 21, 2000, Rule No. 44) Extract
1. These Regulations shall come into force on April 1, 2000.
Supplementary Provision (Revision: February 20, 2001, Rule No. 11)
These Detailed Rules shall come into force on April 1, 2001.
Supplementary Provision (Revision: April 8, 2002, Rule No. 110)
These Detailed Rules shall come into force on April 8, 2002, and the revised provisions of Articles 1, 4, and 5 shall apply on and after April 1, 2002.
Supplementary Provision (Revision: April 1, 2003, Rule No. 33)
These Detailed Rules shall come into force on April 1, 2003.
Supplementary Provision (Revision: April 1, 2004, Rule No. 237)
These Detailed Rules shall come into force on April 1, 2004.
Supplementary Provision (Revision: October 26, 2004, Rule No. 321)
These Detailed Rules shall come into force on October 26, 2004, and the revised provision of Article 1 shall apply on and after October 1, 2004.
Supplementary Provision (Revision: April 1, 2005, Rule No. 111)
These Detailed Rules shall come into force on April 1, 2005.
Supplementary Provision (Revision: May 23, 2006, Rule No. 113)
These Detailed Rules shall come into force on May 23, 2006, and the revised provision of Article 1 shall apply on and after April 1, 2006.
Supplementary Provision (Revision: April 10, 2007, Rule No. 108)
These Detailed Rules shall come into force on April 10, 2007, and the revised provision of Article 1 shall apply on and after April 1, 2007.
Supplementary Provision (Revision: March 11, 2008, Rule No. 21)
These Detailed Rules shall come into force on March 11, 2008.
Supplementary Provision (Revision: April 22, 2008, Rule No. 86)
These Detailed Rules shall come into force on April 22, 2008, and the revised provision of Article 1 shall apply on and after

April 1, 2008.

Supplementary Provision (Revision: September 29, 2008, Rule No. 143)

These Detailed Rules shall come into force on October 1, 2008.

Supplementary Provision (Revision: April 14, 2009, Rule No. 65)

These Detailed Rules shall come into force on April 14, 2009, and the revised provision of Article 1 shall apply on and after April 1, 2009.

Supplementary Provision (Revision: December 8, 2009, Rule No. 113)

These Detailed Rules shall come into force on December 8, 2009, and the revised provision of Article 1 shall apply on and after December 1, 2009.

Supplementary Provision (Revision: May 8, 2012, Rule No. 54)

These Detailed Rules shall come into force on May 8, 2012, and the revised provision of Article 1 shall apply on and after February 1, 2012.

Supplementary Provision (Revision: April 23, 2013, Rule No. 68)

These Detailed Rules shall come into force on April 23, 2013, and the revised provision of Article 1 shall apply on and after April 1, 2013.

Supplementary Provision (Revision: April 22, 2014, Rule No. 86)

These Detailed Rules shall come into force on April 22, 2014, and the revised provision of Article 1 shall apply on and after April 1, 2014.

Supplementary Provision (Revision: April 28, 2015, Rule No. 70)

These Regulations shall come into force on April 28, 2015, and apply on and after April 1, 2015.

Supplementary Provision (Revision: April 26, 2016, Rule No. 60)

These Regulations shall come into force on April 26, 2016 [omitted], and apply on and after April 1, 2016.

Supplementary Provision (Revision: April 25, 2017, Rule No. 86)

These Detailed Rules shall come into force on April 25, 2017, and the revised provision of Article 1 shall apply on and after April 1, 2017.

Supplementary Provision (Revision: May 8, 2018, Rule No. 112)

These Regulations shall come into force on May 8, 2018. The revised provisions of Articles 1 (limited to the part changing "or" to ", the part changing "Article 29" to "Article 27", and the part adding "the Advanced Institute for Materials Research, or the Frontier Research Institute for Interdisciplinary Sciences" after "one of the centers, etc. prescribed in Articles 22 to 29 of the Regulations on Management of Organization") shall apply on and after January 30, 2018. The revised provisions of said Article (limited to the part deleting ", the Education Division or Research Division"), and the revised provisions of Articles 4 and 5 shall apply on and after April 1, 2018.

Supplementary Provision (Revision: April 23, 2019, Rule No. 74)

These Detailed Rules shall come into force on April 23, 2019, and the revised provision of Article 1 shall apply on and after April 1, 2019.

Supplementary Provision (Revision: November 26, 2019, Rule No. 78)

These Detailed Rules shall come into force on November 26, 2019, and the revised provision of Article 1 shall apply on and after October 1, 2019.

Regulations on Tohoku University Academic Degrees

(Purpose)

Article 1 Degrees that Tohoku University (hereinafter referred to as the “University”) confers upon students pursuant to the provision of Article 13, Paragraph 1 of the Degree Regulations (Ordinance of the Ministry of Education, Science and Culture No. 9 of 1953) shall be as provided for in these Regulations, in addition to the provisions of the Tohoku University Faculty General Rules (established on December 18, 1952), and those of the Tohoku University Graduate School General Rules (Established on November 16, 1953).

(Degrees)

Article 2 (1) Degrees that the University confers upon students shall be bachelor’s degrees, master’s degrees, doctoral degrees, and professional degrees.

(2) In conferring a bachelor’s degree, the title of the relevant major field shall be appended in accordance with the following categorization:

School of Arts and Letters: Degree of Bachelor (Literature)
School of Education: Degree of Bachelor (Education)
School of Law: Degree of Bachelor (Law)
School of Economics: Degree of Bachelor (Economics)
School of Science: Degree of Bachelor (Science)
School of Medicine: Degree of Bachelor (Medicine, Nursing Sciences, or Health Sciences)
School of Dentistry: Degree of Bachelor (Dentistry)
School of Pharmaceutical Sciences: Degree of Bachelor (Pharmaceutical Sciences, or Pharmacy)
School of Engineering: Degree of Bachelor (Engineering)
School of Agriculture: Degree of Bachelor (Agricultural Science)

(3) In conferring a master’s degree, the title of the relevant major field shall be appended in accordance with the following categorization:

Graduate School of Arts and Letters: Degree of Master (Literature)
Graduate School of Education: Degree of Master (Education, or Educational Informatics)
Graduate School of Law: Degree of Master (Law)
Graduate School of Economics and Management: Degree of Master (Economics, or Business Management)
Graduate School of Science: Degree of Master (Science)
Graduate School of Medicine: Degree of Master (Medical Sciences, Disability Sciences, Nursing Sciences, Health Sciences, or Public Health)
Graduate School of Dentistry: Degree of Master (Oral Sciences)
Graduate School of Pharmaceutical Sciences: Degree of Master (Pharmaceutical Sciences)
Graduate School of Engineering: Degree of Master (Engineering)
Graduate School of Agricultural Science: Degree of Master (Agricultural Science)
Graduate School of International Cultural Studies: Degree of Master (International Cultural Studies)
Graduate School of Information Sciences: Degree of Master (Information Sciences)
Graduate School of Life Sciences: Degree of Master (Life Sciences)
Graduate School of Environmental Studies: Degree of Master (Environmental Studies)
Graduate School of Biomedical Engineering: Degree of Master (Biomedical Engineering)

(4) In conferring a doctoral degree pursuant to the provision of Article 4 (1), the title of the relevant major field shall be appended in accordance with the following categorization:

Graduate School of Arts and Letters: Degree of Doctor (Literature)
Graduate School of Education: Degree of Doctor (Education, or Educational Informatics)
Graduate School of Law: Degree of Doctor (Law)
Graduate School of Economics and Management: Degree of Doctor (Economics, or Business Management)
Graduate School of Science: Degree of Doctor (Science)

Graduate School of Medicine: Degree of Doctor (Medicine, Disability Sciences, Nursing Sciences, or Health Sciences)
Graduate School of Dentistry: Degree of Doctor (Dentistry)
Graduate School of Pharmaceutical Sciences: Degree of Doctor (Pharmaceutical Sciences, or Pharmacy)
Graduate School of Engineering: Degree of Doctor (Engineering)
Graduate School of Agricultural Science: Degree of Doctor (Agricultural Science)
Graduate School of International Cultural Studies: Degree of Doctor (International Cultural Studies)
Graduate School of Information Sciences: Degree of Doctor (Information Sciences)
Graduate School of Life Sciences: Degree of Doctor (Life Sciences)
Graduate School of Environmental Studies: Degree of Doctor (Environmental Studies)
Graduate School of Biomedical Engineering: Degree of Doctor (Biomedical Engineering)

(5) In addition to the provisions of the preceding Article 2 (3) and (4), when a master's degree or doctoral degree is conferred, the title of the relevant major field may be appended as "Degree of Master (Academic Field)" or "Degree of Doctor (Academic Field)."

(6) In conferring a doctoral degree pursuant to the provision of Article 4 (2), the title of the relevant major field shall be appended, and the provisions of the preceding Article 2 (4) and (5) shall apply mutatis mutandis to such title.

(7) Professional degrees to be conferred pursuant to the provision of Article 4-2 shall be as follows:
Graduate School of Law: Degree of master's in public law and Policy (Professional Degree), or Juris Doctor (Professional Degree)
Graduate School of Economics and Management: Degree of master's in accountancy (Professional Degree)

(Requirements for Conferral of bachelor's Degrees)

Article 2-2 (1) A bachelor's degree shall be conferred upon a person who graduated from the University.

(2) In addition to the provision of the preceding Article 2-2 (1), the conferral of bachelor's degrees shall be prescribed separately.

(Requirements for Conferral of master's Degrees)

Article 3 A master's degree shall be conferred upon a person who has completed a master's course, or the first two years of a doctoral course (hereinafter collectively referred to as a "Master's Course, etc."), offered by a graduate school of the University.

(Requirements for Conferral of Doctoral Degrees)

Article 4 (1) A doctoral degree shall be conferred upon a person who has completed a doctoral course offered by a graduate school of the University.

(2) In addition to the provision of the preceding Article 4 (1), a doctoral degree may be conferred upon a person who has not gone through a doctoral course, provided that such person has passed the review of his/her doctoral dissertation, and that his/her academic abilities are confirmed as at least equivalent to those of doctoral course graduates.

(Requirements for Conferral of Professional Degrees)

Article 4-2 A professional degree shall be conferred upon a person who completed a professional degree program offered by a graduate school of the University.

(Submission of Academic Dissertations by Persons in Graduate Courses)

Article 5 (1) An academic dissertation (or research results in the case where the person concerned is to be evaluated on the basis of the results of his/her research on a specific topic in a master's Course, etc.; the same shall apply hereinafter) of a person enrolled in a graduate course of the University (except for professional degree programs) shall be submitted to the dean of his/her graduate school.

(2) Upon receipt of such academic dissertation in the preceding Article 5 (1), the dean of the receiving graduate school shall refer it to the Faculty Meeting or Graduate School Committee (hereinafter referred to as the "Faculty Meeting, etc.") for evaluation of the person concerned to make a decision as to whether a degree should be awarded to him/her.

(Application for Degree Conferral by a Person without completing a Graduate Course)

Article 6 (1) A person who intends to apply for conferral of a degree in accordance with the provision of Article 4 (2) (hereinafter referred to as a "Degree Applicant") shall submit an degree application form with a doctoral dissertation, a curriculum vitae, a dissertation index, a dissertation abstract, and an academic dissertation review fee, and with the title of the major field associated with the contents of his/her doctoral dissertation specified, to the President of the University through the dean of the graduate school concerned with the application.

(2) The amount of the academic dissertation review fee shall be 150,000 yen per case; provided, however, that the amount shall be 75,000 yen per case in the case where the Degree Applicant was enrolled in an undergraduate school or graduate school of the University (except for persons whose enrollment was based on the status as a Credited Auditor, Special Auditing Student, Pre-Undergraduate Education Recipient, Special Research Student, or Research Student), or is or was an employee of the University (meaning an employee under Article 2 (1) of the Work Rules for Employees at National University Corporation Tohoku University [Rule No. 46 of 2004] or a Fixed-Term Employees under Article 2 of the Work Rules for Fixed-Term Employees at National University Corporation Tohoku University [Rule No. 26 of 2009] [except for Visiting Research Scholars [meaning those prescribed in Article 6 (2) of the same Rules]; the same shall apply hereinafter).

(3) Upon receipt of the application in Article 6 (1), the dean of the receiving graduate school shall transfer the degree application form to the President of the University, and also refer the application to the Faculty Meeting, etc. for evaluation of it to make a decision as to whether the degree should be awarded to the Degree Applicant.

(Academic Dissertation)

Article 7 (1) The academic dissertation prescribed in Article 5 (1) and Article 6 (1) (hereinafter an"Academic Dissertation") shall be limited to one paper; provided, however, that other papers may be attached thereto as references.

(2) The submission of any duplicate copies or translated copies of an Academic Dissertation, or any models, specimens, etc. may be ordered as may be necessary for review.

(Return of Academic Dissertations and Academic Dissertation Review Fee)

Article 8 Received academic dissertations or academic dissertation review fees shall not be returned for any reason.

(Reviewers)

Article 9 (1)In the case where the evaluation as to whether a degree should be awarded to a person pursuant to the provision of Article 5 (2) or Article 6 (3) is referred to the Faculty Meeting, etc., the Faculty Meeting, etc. shall appoint at least two reviewers from among full-time professors at the relevant graduate school, and/or graduate school faculty members who are full-time professors assigned to collaborative courses set under the graduate school concerned, or assigned to research divisions, etc., such as research institutes, that constitute part of the graduate school concerned on the basis of Article 2 (1) of the Regulations on Organizational Management of Tohoku University Graduate School. Thereafter, the Faculty Meeting, etc. shall delegate such reviewers to review the Academic Dissertation of the person concerned, and to arrange the person's final examination or confirm his/her academic abilities.

(2) Notwithstanding the provision of the preceding Article 9 (1), when finding it necessary, the Faculty Meeting, etc. may delegate the University's graduate school faculty members, etc. other than the reviewers in the preceding Article 9 (1) to serve as reviewers to implement the review of an Academic Dissertation, and the arrangement of the final examination or the confirmation of academic abilities.

(3) Notwithstanding the provision of Article 9 (1), when finding it necessary, the Faculty Meeting, etc. may delegate the review of an Academic Dissertation to faculty members at other graduate schools, research institutes, etc.

(Review Period)

Article 10 The review of a doctoral dissertation, and the final examination and/or academic ability confirmation in relation to the conferral of a doctoral degree shall be completed in a manner that a decision as to whether a doctoral degree should be awarded to the person concerned can be made within one year of receipt of his/her doctoral dissertation or application for such conferral; provided, however, that this period may be extended through deliberation by the Faculty Meeting, etc., if there are special grounds for such extension.

(Interviews)

Article 10-2 For the review of a doctoral dissertation of a person who has applied for the conferral of a degree in accordance with the provision of Article 4 (2), an interview shall be held, unless the Faculty Meeting, etc. find special grounds for omitting such interview.

(Final Examination)

Article 11 After the completion of review of an Academic Dissertation, the final examination shall be conducted in an oral or written form and pertain centrally to the Academic Dissertation and also to subjects connected thereto.

(Method of Academic Ability Confirmation)

Article 12 (1) The confirmation of academic abilities shall be carried out in relation to subjects in the major field associated with the relevant doctoral dissertation, and (a) foreign language(s).

(2) Notwithstanding the provision of the preceding Article 12 (1), the confirmation of academic abilities may be carried out only in relation to subjects in the major field associated with the doctoral dissertation concerned, or may be carried out as separately prescribed, if the Faculty Meeting, etc. find special grounds for such manner of confirmation.

(Omission of Review)

Article 12-2 Reviewers shall omit the final examination and academic ability confirmation in cases where the person concerned fails in the review of his/her Academic Dissertation.

(Reporting by Reviewers)

Article 13 Upon completion of a review, the reviewers shall immediately report the results of such review to the faculty Meeting, etc.

(Resolution of Degree Conferral)

Article 14 The conferral of a degree shall require the approval of at least two-thirds of the participants in the Faculty Meeting, etc.

(Reporting by the Dean of the Graduate School)

Article 15 (1) In cases where the Faculty Meeting, etc. pass a resolution in favor of awarding a degree to a person, the dean of the relevant graduate school shall report to the President of the University a summary of the results of the Academic Dissertation review, and the final examination or academic ability confirmation, and any other relevant details.

(2) In cases where, with regard to an applicant for conferral of a degree pursuant to the provision of Article 4 (2), the Faculty Meeting, etc. pass a resolution against awarding a degree to such applicant, the dean of the relevant graduate school shall report to the President of the University on a summary of the results of the doctoral dissertation review and academic ability confirmation; provided, however, that if the confirmation of academic abilities has not been implemented pursuant to the provision of Article 12-2, it is not necessary to report a summary of the confirmation results.

(Conferral of Degrees)

Article 16 (1) When approving a person as qualified to receive a degree on the basis of the report prescribed in the provision of Article 15 (1), the President of the University shall confer a degree upon the person.

(2) When determining a person as not qualified to receive a degree on the basis of the report prescribed in the provision of Article 15 (2), the President of the University shall notify the person to that effect.

(Publication of Dissertation Abstracts, etc.)

Article 17 Upon conferring a doctoral degree pursuant to the provision of Article 16 (1), the President of the University shall publish an abstract of the contents of the dissertation associated with the conferral of the doctoral degree concerned, and a summary of the results of the relevant dissertation review, through the Internet within three months of the day of the conferral.

(Publication of Academic Dissertations)

Article 18 (1) Upon receipt of a doctoral degree, the recipient shall publish the full text of his/her doctoral dissertation within one year of the day of conferral of the degree, unless the recipient has already published the text prior to the conferral.

(2) Notwithstanding the provision of the preceding Article 18 (1), under unavoidable circumstances, the recipient of a doctoral degree may publish an abstract of his/her doctoral dissertation in lieu of its full text, upon obtaining the approval of the dean of the relevant graduate school; in this case, the dean shall make the full text of the dissertation available for viewing upon request.

(3) The publication by the recipient of a doctoral degree pursuant to the preceding Article 18 (1) and (2) shall be carried out through the Internet as separately prescribed.

(4) In publishing a doctoral dissertation pursuant to the provision of Article 18 (1), the dissertation shall specify, "Academic Dissertation (Doctoral) Reviewed by Tohoku University"; in publishing an abstract of a doctoral dissertation pursuant to the provision of Article 18 (2), the abstract shall specify, "Abstract of an Academic Dissertation (Doctoral) Reviewed by Tohoku University."

(Revocation of Degree Conferral)

Article 19 (1) In cases where the recipient of a degree falls under any of the following items, the President of the University shall, through deliberation by the Faculty Meeting, etc. and the Academic Affairs Council, revoke the already conferred degree, require the recipient to return his/her degree certificate, and announce this revocation:

(i) Where the fact becomes evident that the receipt of the degree was based on an improper method; or

(ii) Where the recipient of the degree has conducted himself/herself in a manner that tarnishes the honor of the degree.

(2) In cases where the Faculty Meeting, etc. deliberate as prescribed in the preceding Article 19 (1), the provision of Article 14 shall apply mutatis mutandis.

(Degree Certificate and Documents Related to Application for Degree Conferral)

Article 20 The formats of degree certificates and documents related to degree conferral application shall be as specified by Appended Forms 1 to 8.

Supplementary Provisions

1. These Regulations shall come into force on January 1, 1955; provided, however, that with regard to the conferral of doctoral degrees upon applicants for such conferral in accordance with the provision of Article 4 (2), the conferral of degrees other than the types of degrees prescribed in Article 1 of the Regulations on Tohoku University Academic Degrees (established on April 4, 1921) shall take place subsequent to the conferral of doctoral degrees upon persons who completed doctoral courses offered by the graduate schools of the University.
2. Notwithstanding the enforcement of these Regulations, the Regulations on Tohoku University Academic Degrees (established on April 4, 1921) shall remain effective up until March 31, 1962 (with regard to Doctors of Medicine, up until March 31, 1960).

Supplementary Provision (Revised on July 1, 1955)

These Regulations shall come into force on July 1, 1955.

Supplementary Provision (Revised on April 1, 1956)

These Regulations shall come into force on April 1, 1956.

Supplementary Provision (Revised on July 21, 1956)

These Regulations shall come into force on July 21, 1956.

Supplementary Provision (Revised on November 24, 1959)

These Regulations shall come into force on November 24, 1959, and apply on and after August 1, 1959.

Supplementary Provision (Revised on September 22, 1960)

These Regulations shall come into force on September 22, 1960 and apply on and after April 1, 1960.

Supplementary Provision (Revised on May 23, 1961)

These Regulations shall come into force on May 23, 1961 and apply on and after April 1, 1961.

Supplementary Provisions (Revision: October 16, 1962, Rule No. 86)

1. These Regulations shall come into force on October 16, 1962.
2. Notwithstanding these Regulations, any degree conferral cases which are pursuant to the provision of Article 4 (2), and are under evaluation at the time of enforcement of these Regulations may be in accordance with the pre-revision Regulations on Tohoku University Academic Degrees.

Supplementary Provision (Revision: April 18, 1967, Rule No. 20)

These Regulations shall come into force on April 18, 1967, and apply to applications for degree conferral received on or after April 1, 1967.

Supplementary Provision (Revision: March 20, 1971, Rule No. 22)

These Regulations shall come into force on April 1, 1971.

Supplementary Provision (Revision: April 18, 1972, Rule No. 40)

These Regulations shall come into force on April 18, 1972, and apply on and after April 1, 1972.

Supplementary Provision (Revision: March 18, 1975, Rule No. 11)

Revised: Rule No. 8 of January 16, 1979

These Regulations shall come into force on April 1, 1975.

Supplementary Provision (Revision: April 20, 1976, Rule No. 40)

These Regulations shall come into force on April 20, 1976, and the provision of Article 6 (1) after revision by these Regulations shall apply on and after April 1 of the same year.

Supplementary Provision (Revision: January 16, 1979, Rule No. 8)

These Regulations shall come into force on January 16, 1979.

Supplementary Provision (Revision: April 17, 1984, Rule No. 16)

These Regulations shall come into force on April 17, 1984, and the provision of Article 6 (1) after revision by these Regulations shall apply on and after April 1, 1984.

Supplementary Provision (Revision: April 21, 1987, Rule No. 29)

These Regulations shall come into force on April 21, 1987, and the provision of Article 6 (1) after revision by these Regulations shall apply on and after April 1, 1987.
Supplementary Provision (Revision: September 14, 1987, Rule No. 61)
These Regulations shall come into force on October 1, 1987.
Supplementary Provision (Revision: February 21, 1989, Rule No. 10)
These Regulations shall come into force on February 21, 1989, and apply on and after January 8, 1989.
Supplementary Provision (Revision: July 16, 1991, Rule No. 55)
These Regulations shall come into force on July 16, 1991, and the revised provisions of the Regulations on Tohoku University Academic Degrees shall apply on and after July 10, 1991.
Supplementary Provision (Revision: June 15, 1992, Rule No. 49)
These Regulations shall come into force on June 15, 1992.
Supplementary Provision (Revision: April 1, 1993, Rule No. 66)
These Regulations shall come into force on April 1, 1993.
Supplementary Provision (Revision: April 1, 1994, Rule No. 23)
These Regulations shall come into force on April 1, 1994.
Supplementary Provision (Revision: September 20, 1994, Rule No. 80)
These Regulations shall come into force on September 20, 1994.
Supplementary Provision (Revision: March 20, 1995, Rule No. 34)
These Regulations shall come into force on April 1, 1995.
Supplementary Provision (Revision: March 19, 1996, Rule No. 32)
These Regulations shall come into force on April 1, 1996.
Supplementary Provisions (Revision: March 21, 2000, Rule No. 43)
1. These Regulations shall come into force on April 1, 2000.
   (Partial revision of the Regulations on Special Provisions Concerning Methods of Confirmation of Academic Abilities)
2. The Regulations on Special Provisions Concerning Methods of Confirmation of Academic Abilities (Rule No. 87 of 1962) shall be partially revised as follows.
   [As follows] Omitted
Supplementary Provision (Revision: February 20, 2001, Rule No. 9)
These Regulations shall come into force on April 1, 2001.
Supplementary Provision (Revision: April 1, 2002, Rule No. 37)
These Regulations shall come into force on April 1, 2002.
Supplementary Provision (Revision: April 1, 2003, Rule No. 9)
These Regulations shall come into force on April 1, 2003.
Supplementary Provision (Revision: October 1, 2003, Rule No. 149)
These Regulations shall come into force on October 1, 2003.
Supplementary Provision (Revision: April 1, 2004, Rule No. 87)
These Regulations shall come into force on April 1, 2004.
Supplementary Provision (Revision: April 1, 2005, Rule No. 32)
These Regulations shall come into force on April 1, 2005, and the revised provisions of Appended Forms 1 to 5 shall apply on and after October 14, 2004.
Supplementary Provision (Revision: April 1, 2006, Rule No. 58)
These Regulations shall come into force on April 1, 2006.
Supplementary Provision (Revision: March 31, 2008, Rule No. 64)
These Regulations shall come into force on April 1, 2008.
Supplementary Provision (Revision: April 14, 2009, Rule No. 76)
These Regulations shall come into force on April 14, 2009, and the revised provision of the proviso of Article 6 (2) shall apply on and after April 1, 2009.
Supplementary Provisions (Revision: March 30, 2010, Rule No. 33)
1. These Regulations shall come into force on April 1, 2010.
2. Notwithstanding the revised provision of Article 2 (3), the titles of major fields to be appended to the degrees of persons

who enrolled in the first two years of doctoral courses offered by the Graduate School of Pharmaceutical Sciences in or prior to academic year 2009 shall continue to conform to the provision then in force.

Supplementary Provisions (Revision: March 26, 2012, Rule No. 32)

1. These Regulations shall come into force on April 1, 2012.
2. Notwithstanding the revised provision of Article 2 (4), the titles of major fields to be appended to the degrees of persons who proceeded or transferred to the latter three-year doctoral courses offered by the Graduate School of Pharmaceutical Sciences in or prior to academic year 2011 shall continue to conform to the provision then in force.

Supplementary Provision (Revision: March 26, 2013, Rule No. 24)

These Regulations shall come into force on April 1, 2013.

Supplementary Provisions (Revision: June 25, 2013, Rule No. 91)

1. These Regulations shall come into force on June 25, 2013.
2. The revised provision of Article 17 shall apply to cases in which doctoral degrees are conferred on or after April 1, 2013, and cases of conferral of doctoral degrees prior to the date shall continue to conform to the provision then in force.
3. The revised provision of Article 18 shall apply to persons upon whom doctoral degrees are conferred on or after April 1, 2013, and persons upon whom doctoral degrees were conferred prior to the aforementioned date shall continue to conform to the provision then in force.

Supplementary Provision (Revision: March 23, 2015, Rule No. 38)

These Regulations shall come into force on April 1, 2015.

Supplementary Provision (Revision: March 28, 2017, Rule No. 39)

These Regulations shall come into force on April 1, 2017.

Supplementary Provisions (Revision: March 29, 2018, Rule No. 56)

1. These Regulations shall come into force on April 1, 2018.
2. Notwithstanding the revised provisions of Article 2 (3) and (4), the titles of major fields to be appended to the degrees of persons who were admitted, or who proceeded or transferred, to the Graduate School of Education, or the Graduate School of Educational Informatics Education Division, in or prior to academic year 2017 shall continue to conform to the provisions then in force.
3. The provisions of Article 5, Article 6 (1) and (3), Article 15, and Article 18 (2) before revision by these Regulations shall continue to be effective while the Graduate School of Educational Informatics Education Division remains in existence on the basis of Supplementary Provision 2. of the Regulations to Partially Revise Tohoku University Graduate School General Rules (Rule No. 54 of 2018).

Appended Form 1 (Degree certificate form to be conferred pursuant to the provision of Article 2-2)

Appended Form 2 (Degree certificate form to be conferred pursuant to the provision of Article 3)

Appended Form 3 (Degree certificate form to be conferred pursuant to the provision of Article 4 (1))

Appended Form 3-2 (Degree certificate form to be conferred, pursuant to the provision of Article 4 (1), upon persons who have completed the degree programs prescribed in Article 2-2 of the Tohoku University Graduate School General Rules)

Appended Form 4 (Degree certificate form to be conferred pursuant to the provision of Article 4 (2))

Appended Form 5 (Degree certificate form to be conferred pursuant to the provision of Article 4-2)

Appended Form 6 (Degree Application Form)

Attachment Form No. 4 (Form of degree conferred pursuant to the provisions of Article 4, Paragraph 2)

Tohoku University
Hereby confers upon
[NAME]

The Degree of
[Degree name]
has submitted a doctoral dissertation and successfully
fulfilled all the requirements on [Month], [Day], [Year]

[President's signature]
[President’s name]
President,
Tohoku University

Appended Format No. 5 (format for degree conferred pursuant to the provisions of Article 4-2)

Tohoku University
Hereby confers upon
[NAME]

The Degree of
[Degree name]
Having completed the
Professional Degree Program
In the discipline
[Department name]
In the Graduate School of
[Graduate school name]
On [Month], [Day], [Year]

[President's signature]
[President’s name]
President,
Tohoku University

Appended Form No. 6 (Form of degree application form pursuant to the provisions of Article 6, Paragraph 1)

Date:

To <<President name>>,
President of Tohoku University:

Current Address:

Name；

Conferral of a Degree of Doctor (Application)

On the basis of the provision of Article 6 (1) of the Regulations on Academic Degrees at Tohoku University, I hereby apply for conferral of a Degree of Doctor ( ) with a doctoral dissertation, related documents, and ＊＊＊＊ yen as the academic dissertation review fee attached hereto.

Dissertation for submission and attached documents:

1. Doctoral dissertation	One copy (copy[ies])
2. Curriculum vitae	One copy
3. Dissertation index	One copy
4. Dissertation abstract	One copy

Note: Enter the title of a major field associated with the contents of the doctoral dissertation in the parentheses, "Degree of Doctor ( )."
[E.g.: Degree of Doctor (Literature), Degree of Doctor (Science)]

Attached Form No. 7 (format for thesis title pursuant to the provisions of Article 6, Paragraph 1)

Dissertation Index

Name	
Doctoral Dissertation:	

Title	Method of Publication	Date of Publication

Reference Papers：Title	Method of Publication	Date of Publication	No. of Copies

Note

1: If the title of any paper (the doctoral dissertation or reference papers) is not written in Japanese, write the title in block letters together with its Japanese translation in parentheses.

2: If any paper (the doctoral dissertation or reference papers) has not been published, state the scheduled method and timing of publication.

3: Regarding reference papers, state the titles and copies of only those that are to be submitted.

Attached Form No. 8 (Resume format pursuant to the provisions of Article 6, Paragraph 1)

Curriculum Vitae

Name		Sex	Male / Female	Date of Birth	Date:
Domicile of Origin		Current Address	Post code:		
Academic Background					
Date:		Graduated from			
Research Background Date:					
Professional Background Date:					

Note

1: Complete the Academic Background by entering details from and after university graduation (if you have not graduated from university, the previous school from which you graduated). In so doing, specify the name(s) of your department(s) and major(s).

2: Complete the Research Background and Professional Background only with the main details.

Appended Form 1 (Degree certificate form to be conferred pursuant to the provision of Article 2-2)
Appended Form 2 (Degree certificate form to be conferred pursuant to the provision of Article 3)
Appended Form 3 (Degree certificate form to be conferred pursuant to the provision of Article 4 (1))
Appended Form 3-2 (Degree certificate form to be conferred, pursuant to the provision of Article 4 (1), upon persons who have completed the degree programs prescribed in Article 2-2 of the Tohoku University Graduate School General Rules)
Appended Form 4 (Degree certificate form to be conferred pursuant to the provision of Article 4 (2))
Appended Form 5 (Degree certificate form to be conferred pursuant to the provision of Article 4-2)
Appended Form 6
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Rules for Tohoku University’s Graduate School of Engineering

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Supplementary Provisions

Chapter I: General Provisions

Article1 These Provisions define practices for admission, educational methods, course completion, etc. at Tohoku University’s Graduate School of Engineering (hereinafter referred to as the “Graduate School”), in addition to the provisions prescribed by the Tohoku University Graduate School General Rules (established on November 16, 1953. Hereinafter referred to as the “General Rules”) and Regulations on Tohoku University Academic Degrees (established on January 1, 1955). Notwithstanding these provisions, the Dean of the Graduate School of Engineering (hereinafter referred to as the “Dean”) may stipulate special provisions as necessary upon deliberation by the Graduate School Committee of the Graduate School of Engineering (hereinafter referred to as the “Graduate School Committee”).

Chapter I-2: Purpose of Education, and Educational Objectives

Article 1-2 In accordance with Tohoku University’s philosophy and educational objectives, the Graduate School aims to foster researchers who are equipped with a rich sense of creativity and advanced research capability in the field of engineering, and who have a strong sense of ethical values and spirit, as well as core professional engineers who are equipped not only with a high level of specialized knowledge but also a long-term outlook and international mindset, and who can contribute to the sustainable development of society.

Article 1-3 To realize the purpose of education set forth in the preceding Article, the educational objectives in the first two years of the course (hereinafter referred to as the “First Phase Course”) shall be to nurture the following knowledge and skills.

1 A broad spectrum of fundamental knowledge and basic academic skills to understand and conduct research into the essence of the research topic
2 Deep knowledge of the field of specialization
3 Interdisciplinary knowledge related to the field of specialization
4 System design skills through integration with knowledge of different fields of specialization
5 Problem-setting skills and problem-solving skills for research
6 A high level of practical skills as well as application and deployment skills for research
7 Language skills necessary to conduct the research
8 Basic skills for exercising research guidance or technical guidance

Article 1-4 To realize the purpose of education set forth in Article 1-2, the educational objectives in the latter three years of the course (hereinafter referred to as the “Latter Phase Course”) shall be to nurture the following skills.

1 Ability to develop research topics from a comprehensive perspective based on social needs, and to put the research into practice
2 Problem-solving skills based on original ideas
3 Thinking skills that can be applied to other fields
4 Adequate language skills for making presentations at international academic conferences, etc., skills in writing academic

papers, debating skills, and communication skills
5 Ability to exercise leadership in research
6 Basic skills for research or project management

Chapter I-3: Majors

Article 2 This Graduate School has the following Majors.

Mechanical Systems and Design
Fine mechanics
Robotics
Aerospace Engineering
Quantum Science and Energy Engineering
Electrical Engineering
Communications Engineering
Electronic Engineering
Applied Physics
Applied Chemistry
Chemical Engineering
Biomolecular Engineering
Metallurgy
Materials Science
Materials Processing
Civil and Environmental Engineering
Architecture and Building Science
Management Science and Technology

Chapter II: Admission, Readmission, Progression, Transfer Admission, Graduate School Transfer, and Major Transfer

Article 3 The screening method for a person who applies for admission in accordance with the provisions of Article 11 of the General Rules, is prescribed separately by the Dean upon deliberation by the Graduate School Committee.

Article 4 A person who applies for readmission to this Graduate School in accordance with Article 13 of the General Rules may be permitted through a screening, provided that it is less than two years after his/her withdrawal or expulsion. However, for a person to whom special circumstances apply, readmission may still be approved even if it is two or more years after his/her withdrawal or expulsion.

2 The screening method in the case of the preceding paragraph shall be prescribed on a case-by-case basis by the Dean, upon deliberation by the Graduate School Committee.

3 The recognition in whole or in part of course subjects already taken, the number of credits already acquired, and the term of study already spent by a person who has been readmitted pursuant to the provisions of Article 4 (1), shall be prescribed on a case-by-case basis by the Dean, upon deliberation by the Graduate School Committee.

Article 5 The screening method for a person who applies for progression, transfer admission, graduate school transfer, and major transfer in accordance with the provisions of Article 14, Article 15, and Article 16 (1) and Article 16 (2) of the General Rules shall be prescribed separately by the Dean, upon deliberation by the Graduate School Committee.

2 The recognition in whole or in part of course subjects already taken, the number of credits already acquired, and the term of study already spent by a person who has been admitted through graduate school transfer and major transfer pursuant to the provisions of Article 5 (1), shall be prescribed on a case-by-case basis by the Dean, upon deliberation by the Graduate School Committee.

Article 5-2 Credits (including credits earned as a non-degree student or special course student) earned by a person who has been admitted to the Graduate School or a transfer student and who has completed the course subjects in the following educational programs before being admitted to the Graduate School or a transfer student may be deemed to be credits earned at the Graduate School if the credits are deemed to be educationally beneficial. (2) Credits earned in the following courses (including credits earned as a non-degree student or a special course student) may be deemed to be credits earned in the Graduate School, if deemed educationally beneficial.

1 Graduate schools of Tohoku University, or graduate schools of other universities (hereinafter referred to as the "Other University's Graduate Schools")
2 Foreign graduate schools or foreign institutions of higher education equivalent thereto (hereinafter referred to as the "Foreign Graduate Schools, etc.")
3 Educational institutions in Japan that are recognized, under the schooling system of such foreign country, as a provider of graduate school courses of such foreign country, and that are separately designated by the Minister of Education, Culture, Sports, Science and Technology, or the United Nations University as set forth in Article 15 (5) of the General Rules (hereinafter referred to as the "Educational Institutions, etc. providing Foreign Graduate Courses")
4 The maximum number of credits that may be deemed as acquired at the Graduate School in accordance with the preceding provision shall be 10 credits.

Chapter III: Educational Methods, etc.

Article 6 The course subjects in this Graduate School shall be classified into specialized fundamental subjects, specialized subjects, and related subjects in the First Phase Course, and common subjects, interdisciplinary fundamental subjects, specialized subjects, and related subjects in the Latter Phase Course.
2 The course subjects, number of credits, and manner of studying of this Graduate School shall be prescribed separately.
3 Classes shall be conducted in the form of lectures, training, experiments, laboratory work, seminars, etc.
4 The contents, etc. of the guidance provided for the preparation of academic dissertations in the Graduate School (Hereinafter referred to as "Research Guidance") shall be prescribed separately by the Dean upon deliberation by the Graduate School Committee.

Article 6-2 The course subjects shall be provided during nighttime, during other specific hours, or at specific times, where necessary.

Article 7 The Dean shall assign an academic advisor to each student upon deliberation by the Graduate School Committee, to provide guidance for the taking of course subjects and to provide Research Guidance.

Article 7-2 At the beginning of each semester or year of study, students must submit a list of the course subjects that they wish to take to the Dean, based on instructions from their academic advisors.

Article 7-3 In cases where a student makes a request to take a curriculum in a systematic manner over a certain period exceeding the applicable standard duration of study due to such circumstances as being in employment or other status, such systematic manner of studying may be permitted by the Dean upon deliberation by the Graduate School Committee.
2 In cases where a student for whom a systematic manner of studying pursuant to the provision of the preceding Article 7-3 (1) has been permitted (hereinafter referred to as a "Long-Term Course Student") makes a request to shorten the period of such manner of studying, the shortening of such period may be permitted by the Dean upon deliberation by the Graduate School Committee.
3 In addition to the provisions in the preceding two paragraphs, other matters necessary in relation to the handling of Long-Term Course Students shall be prescribed separately by the Dean upon deliberation by the Graduate School Committee.

Article 7-4 A student may take course subjects offered by other majors or graduate schools or course subjects offered by other faculties, or receive a part of their Research Guidance from other graduate schools, with permission from the Dean upon deliberation by the Graduate School Committee, and as prescribed separately by the Dean.
2 In cases where a student of another graduate school makes a request to take a course subject in this Graduate School or to receive part of their Research Guidance in the Graduate School, such a request may be permitted.

Article 8 The accreditation of course subject completion shall be conducted through examinations. Students who have passed their examinations shall receive the designated number of credits. However, the accreditation of course subject completion for experiments, laboratory work and seminars may be conducted through other methods in lieu of examinations.
2 Examinations are conducted at the end of the semester or year of study by the class instructor who taught the course subject. However, in cases where the class instructor who taught the class has retired or has been in an accident, the examination shall be conducted by other instructors designated by the Dean.
3 Students may only take the examinations of the course subjects they have taken classes for.
4 A student who should have completed the First Phase Course or doctoral course in March of that year but who failed to

do so, may be offered a makeup examination only when deemed necessary by the Dean, upon deliberation by the Graduate School Committee.

5 Examination performance shall be evaluated with 100 as the full score, and 60 as the passing score.

6 The grades assigned in accordance with the preceding paragraph are not publicly disclosed.

Chapter III-2: Studying at Other Universities' Graduate Schools, etc., and Study Abroad, etc.

Article 8-2 A student may, with the permission of the Dean and upon deliberation by the Graduate School Committee, be allowed to take course subjects offered by Other Universities' Graduate Schools as prescribed separately by the Dean.

2 The provision of the preceding Article 8-2 (1) shall apply mutatis mutandis to cases in which students take course subjects in Japan through correspondence education provided by Foreign Graduate Schools, etc., or in which students in Japan take course subjects in the curricula of Foreign Graduate Schools through Educational Institutions, etc. providing Foreign Graduate Courses.

Article 8-2-2 A student may, with the permission of the Dean, receive part of their Research Guidance at Other Universities' Graduate Schools, research institutes, etc. (hereinafter referred to as "Other Universities' Graduate Schools, etc."), or Educational Institutions, etc. providing Foreign Graduate Courses, as prescribed separately by the Dean upon deliberation by the Graduate School Committee. In this case, the period during which First Phase Course students may receive such Research Guidance shall not exceed one year.

Article 8-3 In cases where the Dean finds it educationally beneficial for students to study at Foreign Graduate Schools, etc. upon deliberation by the Graduate School Committee, the Graduate School may, upon prior consultation with such Foreign Graduate Schools, etc., allow students to study abroad at such Foreign Graduate Schools, etc.

2 Notwithstanding the provision of the preceding Article 8-3 (1), the consultation with such Foreign Graduate Schools, etc. in advance may be omitted if the Dean finds there are special circumstances, upon deliberation by the Graduate School Committee.

3 A period of study abroad shall be included in the term of study.

4 The provisions of the preceding Article 8-3 (1) and 8-3 (2) shall apply mutatis mutandis to cases in which students study at Foreign Graduate Schools, etc. while on leave of absence.

Article 8-4 Credits acquired by taking course subjects pursuant to the provisions of Article 8-2, Research Guidance received pursuant to the provision of Article 8-2-2, and achievements made by studying abroad and/or by studying while on leave of absence pursuant to the provisions of the preceding Article 8-3 (1) and 8-3 (4), shall be deemed as credits acquired at the Graduate School and/or Research Guidance received at the Graduate School as prescribed by the Dean, upon deliberation by the Graduate School Committee.

2 The maximum number of credits that may be deemed as acquired at the Graduate School in accordance with the provisions of the preceding Article 8-4 (1) shall be 10 credits.

Article 8-5 In addition to the provisions in this Chapter, the Dean shall prescribe separately, upon deliberation by the Graduate School Committee, matters necessary for studying at Other Graduate Schools, etc., taking course subjects in Japan through correspondence education provided by Foreign Graduate Schools, etc., taking course subjects in foreign graduate school courses, etc. provided by Educational Institutions, etc. providing Foreign Graduate Courses, etc. in Japan, and studying abroad at Foreign Graduate Schools, etc. and/or studying at Foreign Universities, etc. while on leave of absence.

Chapter IV: Course Completion

Article 9 The completion of the First Phase Course shall require at least two years of enrollment in the course, the acquisition of at least 30 credits from a combination of the specialized fundamental subjects, specialized subjects, and related subjects in the major, as well as the submission of a master's dissertation or research achievements on a specific assignment (hereinafter referred to as "Master's Dissertation, etc.") as prescribed separately by the Dean upon deliberation by the Graduate School Committee and upon receipt of the necessary Research Guidance, and the passing of the review of such dissertation and the final examination; provided, however, that with regard to the term of study, one year or more of enrollment shall be sufficient for persons whose research achievements are regarded as outstanding by the Dean, upon deliberation by the Graduate School Committee.

2 In the case referred to in the preceding paragraph, when deemed necessary for the achievement of the objectives of the

doctoral course, the passing of the examination and assessment specified in the following items may be set as a requirement for the completion of the First Phase Course, in lieu of the passing of the review of a Master's Dissertation, etc. and the final examination:

1 An examination on highly specialized knowledge and abilities in relation to the major field concerned, and on matters that constitute a basic background of fields associated with the major field concerned and that should be acquired or developed during the First Phase Course.

2 An assessment of abilities that are necessary for independent execution of research associated with the person's doctoral dissertation, and that should be acquired during the First Phase Course.

Article 10 The completion of the doctoral course shall require at least three years of enrollment in the Latter Phase Course, the acquisition of at least 16 credits from a combination of the interdisciplinary fundamental subjects, specialized subjects, and related subjects in the major (of which, at least 12 credits from a combination of interdisciplinary fundamental subjects and specialized subjects), as well as the passing of the review of the doctoral dissertation, submitted upon receipt of the necessary Research Guidance, and of the final examination; provided, however, that with regard to the term of study, one year (for a person who has completed the master's course in less than two years, three years including that said term of study) or more of enrollment shall be sufficient for persons whose research achievements are regarded as outstanding by the Dean, upon deliberation by the Graduate School Committee.

Article 11 Deleted

Article 12 The Master's Dissertation, etc. may only be submitted by a person who has been enrolled for at least one year in the First Phase Course, who has acquired at least 20 credits from a combination of the specialized fundamental subjects, specialized subjects, and related subjects in the major, and who has received Research Guidance.

2 A person who wishes to submit the Master's Dissertation, etc. for review must submit the title of the dissertation or assignment to the Dean by November 10 for those who expect to complete the course in March, and by June 10 for those who expect to complete the course in September. However, a person who fails to submit the title of the dissertation or assignment by the deadline while on leave of absence may submit it to the Dean upon returning to study.

3 The Master's Dissertation, etc. must be submitted to the Dean by February 10 for those who expect to complete the course in March, and by August 10 for those who expect to complete the course in September.

4 The submission of the Master's Dissertation, etc. in accordance with the provision of the proviso of Article 9 (1) shall be prescribed separately by the Dean, upon deliberation by the Graduate School Committee.

Article 13 The doctoral dissertation may only be submitted by a person who has been enrolled for at least two years in the Latter Phase Course, who has acquired the stipulated number of credits from a combination of the interdisciplinary fundamental subjects, specialized subjects, and related subjects in the major, and who has received the necessary Research Guidance.

2 A person who wishes to submit the doctoral dissertation for review must submit the title of the dissertation to the Dean by November 10 for those who expect to complete the course in March, and by June 10 for those who expect to complete the course in September. However, a person who fails to submit the title of the dissertation by the deadline while on leave of absence may submit it to the Dean upon returning to study.

3 Master's theses, etc. must be submitted to the Dean of the Graduate School by February 10 for students expected to complete in March, and by August 10 for students expected to complete in September.

4 The submission of the doctoral dissertation in accordance with the provision of the proviso of Article 10 shall be prescribed separately by the Dean, upon deliberation by the Graduate School Committee.

Article 14 The final examination shall be conducted for students who have acquired all the credits necessary for completing the First Phase Course or the Latter Phase Course, and who have submitted the Master's Dissertation, etc. or the doctoral dissertation.

2 The final examination shall be conducted as an oral examination on the fields of specialization related to the Master's Dissertation, etc. or the doctoral dissertation.

Article 15 A person who should have completed the First Phase Course in March of a year but who failed to do so, may be offered a makeup review of the Master's Dissertation, etc. and/or makeup final examination when deemed necessary by the Dean, upon deliberation by the Graduate School Committee.

2 The provisions of Article 12 and the preceding article shall apply mutatis mutandis to the makeup review and makeup examination set forth in the preceding paragraph.

Article 16 The results of the Master's Dissertation, etc., the doctoral dissertation, and the final examination, shall be pass or fail.

Article 17 Approval of course completion shall be prescribed by the Dean, upon deliberation by the Graduate School Committee.

Chapter V: Credited Auditors

Article 18 A person may be enrolled as a Credited Auditor only if he/she fulfills one or more of the following criteria.

1 A person who has graduated from university

2 A person who has completed a 16-year curriculum of schooling abroad

3 A person designated by the Minister of Education, Culture, Sports, Science and Technology based on the Public Notice of the Ministry of Education, Science and Culture No. 5 of 1953

4 A person deemed to have equivalent or higher academic abilities as in the three preceding items

Article 19 A person who wishes to apply to be a Credited Auditor must submit the prescribed application forms with the necessary documents attached to the Dean.

Article 20 The selection process for a person who applies to be a Credited Auditor shall be prescribed by the Dean, upon deliberation by the Graduate School Committee.

Article 21 The term of study of a Credited Auditor shall be less than one year. However, an extension not exceeding one year may be granted if a request to continue the term of study as a Credited Auditor is submitted.

Article 22 A Credited Auditor may acquire credits by taking the prescribed examinations for the course subjects he/she takes.

Article 23 A certificate of the acquisition of credits may be issued by the Dean if the Credited Auditor submits a request for a certificate.

Chapter VI: Special Auditing Students and Special Research Students

Article 24 In cases where students belong to Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses apply to take course subjects offered by the Graduate School, the Graduate School may permit the acceptance of such students as Special Auditing Students, as prescribed through consultation with such Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses.

Article 25 In cases where students of Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses apply to receive Research Guidance at the Graduate School, the Graduate School may permit the acceptance of such students as Special Research Students, as prescribed through consultation with such Other Universities' Graduate Schools, Foreign Graduate Schools, etc., or Educational Institutions, etc. providing Foreign Graduate Courses.

Article 26 Matters necessary in relation to the acceptance of Special Auditing Students and Special Research Students shall be prescribed separately by the Dean upon deliberation by the Graduate School Committee.

Supplementary Provisions

These Rules shall come into force on January 1, 1955. However, Provisions in relation to the doctoral course shall apply on and after April 1, 1955.

(Abbreviated)

Supplementary Provisions (Revision: March 23, 2015, Rule No. 18)

These Rules shall come into force on April 1, 2015.

Supplementary Provisions (Revision: March 30, 2016, Rule No. 57)

These Rules shall come into force on April 1, 2016.

Supplementary Provisions (Revision: March 28, 2017, Rule No. 55)

These Rules shall come into force on April 1, 2017.

Supplementary Provisions (Revision: May 8, 2018, Rule No. 98)

1 These Rules shall come into force on May 8, 2018, and the revised provisions of Article 7-4 shall apply on and after April 1, 2018.

2 The provisions of Article 7-4 (2) of the Rules for Tohoku University's Graduate School of Engineering prior to the revision pursuant to this Rules, shall continue to be effective while the Graduate School of Educational Informatics Education

Division remains in existence on the basis of Supplementary Provision 2. of the Regulations to Partially Revise the Tohoku University Graduate School General Rules (Rule No. 54 of 2018).

Tohoku University Graduate School of Engineering Internal Regulations on Enrollment

December 27, 2005
Established

Tohoku University Graduate School of Engineering Internal Regulations on Enrollment

(Purpose)
Article 1
These Internal Regulations prescribe the course subjects, number of credits and manner of studying at the Tohoku University Graduate School of Engineering (hereinafter referred to as the “Graduate School”) pursuant to the provisions of Article 6 (2) of the Rules for Tohoku University’s Graduate School of Engineering (established on January 1, 1955; hereinafter referred to as the “Rules”).

(Course Subject, Number of Credits and Manner of Studying)
Article 2
The course subjects, number of credits and manner of studying at the Graduate School shall be prescribed in Appended Table 1 for the first two years of the doctoral course (hereinafter referred to as the “First Phase Course”) and in Appended Table 2 for the latter three years of the doctoral course (hereinafter referred to as the “Latter Phase Course”).

Supplementary Provisions
1 These Internal Regulations shall come into force from January 1, 2006.
2 Notwithstanding the provision of the Internal Regulations, course subjects, number of credits and manner of studying for persons who were admitted to the Graduate School, advanced, or transferred to the Graduate School during or before academic year 2004 shall be the course subjects, number of credits and manner of studying applied from the Rules prior to revision on the date prior to the date these Internal Regulations come into effect.
Appended Tables omitted

Internal Regulations for Studying at Other Universities, Studying Abroad, Special Auditing Students, and Special Research Students

February 7, 1973, Graduate School Faculty Council
Latest revision February 7, 2007, Dean’s Committee

(Objectives)

Article 1 These internal regulations govern studies at the graduate schools of other universities or research institutes (hereafter, "other universities etc."), studies abroad at foreign universities, graduate schools, or equivalent institutions of higher education (hereafter "foreign universities etc.") and Special Auditing Students and Special Research Students, pursuant to Articles 8-5, 24, and 25 of the Regulations of the Tohoku University Graduate School of Engineering (hereafter, "the Regulations").

(Consultation with other universities etc.)

Article 2 The wording "when the Graduate School Faculty Council determines that it will be educationally beneficial" specified in Articles 8-2, 8-2-2 and 8-3 of the Regulations shall be taken to mean that that the Graduate School Faculty Council determines educational benefit in cases where permission has been granted by the Dean of the department to which the student belongs.

2 The wording "after consultation with that school" specified in Articles 8-2, 8-2-2 and 8-3 of the Regulations shall be taken to mean that a certificate of acceptance or informal acceptance from the graduate school in question may be substituted for "consultation with that school."

(Determining courses)

Article 3 Students wishing to study courses at other universities etc., or at foreign universities etc., must obtain permission from their academic advisor and the Dean of the department to which they belong.

Article 4 Courses taken pursuant to the above article shall be recognized as major general subjects, and related subjects of other majors, other than the requirements stipulated in Tables 1 & 2 of the Internal Regulations on Course Requirements in the Tohoku University Graduate School of Engineering.

Article 5 In cases where students that have transferred from other universities or departments apply for recognition of credits pursuant to the previous two articles, credits that were likewise recognized at the former university or department shall be included.

(Application to study at other universities or study abroad)

Article 6 Students wishing to study courses at other universities etc., or at foreign universities etc., must obtain permission from their academic advisor and the Dean of the department to which they belong, and submit an application to the Dean of the Graduate School of Engineering.

(Special Auditing Students and Special Research Students)

Article 7 Entrance shall be granted to Special Auditing Students and Special Research Students who obtain a letter of recommendation from the president of their home college, and the informal consent of the instructors at the Tohoku University department to which they propose to enter.

Article 8 Recognition of courses taken by Special Auditing Students shall conform to Article 8 of the Regulations (excluding Item 4).

Article 9 Certification of research guidance received by Special Research Students shall be performed by each department.

Supplementary Regulation (Revised February 7, 2007)

This revision became effective as of April 1, 2007.

Regulations on Handling of Tuition Waiver, Deferment, and Monthly Installment Payment of Tohoku University Students

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Chapter I General Provisions

(Purpose)

Article 1 These Regulations prescribe the handling of the tuition waiver, deferment, and monthly installment payment of Tohoku University (hereinafter referred to as the "University") undergraduate students and graduate students, on the basis of the provisions of Article 34 (2) of the Tohoku University Faculty Regulations (established on December 18, 1952), and Article 43 (2) of the Tohoku University Graduate School Regulations (established on November 16, 1953).

Chapter II Tuition Waiver

Section 1 Tuition Waiver for Financial Reasons

(Permission for Waiver)

Article 2 (1) A tuition waiver may be permitted for a particularly excellent person, at his/her request, who is found to experience significant difficulty in studying due to financial reasons.

(2) Notwithstanding the provision of the preceding Article 2 (1), a tuition waiver shall not be permitted for students who violate any regulations or orders of the University, or act contrary to their duties as students, unless there are special circumstances.

(Implementation Method of Waiver)

Article 3 The permission for a tuition waiver shall be given for each semester.

(Amount to Be Waived)

Article 4 The amount of tuition to be waived shall be one-third, half, two-thirds or the full amount of tuition due for a semester.

(Request for Permission)

Article 5 (1)A person who intends to request permission for a tuition waiver shall submit the documents specified in the following items to the President of the University by the prescribed due date:

(i) A tuition waiver request form.

(ii) A certificate issued by the head of the person's local government pertaining to income.

(iii) Other documents regarded as necessary by the President of the University.

(2) Notwithstanding the provision of the preceding Article 5 (1), in cases where a foreign national requests a tuition waiver, he/she may submit the separately prescribed documents in lieu of the document prescribed in Article 5 (1) (ii).

(Admission Fee Collection Deferment)

Article 6 For a person who has requested permission for a tuition waiver, the collection of tuition shall be deferred until a decision concerning such request is made (excluding cases where a person who has made the application referred to in Article 9, Paragraph 1 of the Regulation for Enforcement of the Act on Support for Study at Universities, etc. [Order of the Ministry of Education, Culture, Sports, Science and Technology No. 6 of 2019] had already paid tuition).

(Due Date for Those Whose Request for Waiver Is Refused)

Article 7 A person whose request for permission for a tuition waiver was refused, or who has been granted permission for a one-third, half, or two-thirds amount tuition waiver (except those who have requested collection deferment in accordance with the provision of Article 20(2) and those who had already paid tuition), shall pay the full amount, or if applicable the two-thirds, half, or one-third amount, of his/her tuition for the relevant semester by the day designated, on the day of notice of such refusal or permission, by the University as the date of direct debit.

(Refunding of Tuition)

Article 7-2 Notwithstanding the provision of Article 35, paragraph (1) of the Undergraduate School General Regulations, those who have been granted a tuition fee waiver and have already paid tuition fees shall be returned the amount equivalent to the amount of tuition fees for which the waiver was granted.

(2) In addition to what is prescribed in the preceding paragraph, with regard to those who applied for tuition fee waiver and who had already paid tuition fees and were granted a leave of absence or withdrawal before the decision on granting or denying the waiver was made, or were removed from the university register due to death or disappearance, the amount equivalent to the amount of the said tuition fees that was granted in Article 14, paragraph 2 shall be returned. With regard to those who have been exempted from tuition fees pursuant to Paragraph 1 of Article 14 as applied mutatis mutandis pursuant to Paragraph 2 of Article 14, the amount equivalent to the tuition fees exempted pursuant to Paragraph 1 of Article 15 as applied mutatis mutandis pursuant to Paragraph 2 of Article 15, or the amount equivalent to the tuition fees exempted pursuant to Paragraph 1 of Article 17 as applied mutatis mutandis pursuant to Paragraph 2 of Article 17 shall be returned.

Section 2 Tuition Waiver for Reasons of Death of Educational Expense Payer, Disaster, Etc.

(Permission for Waiver)

Article 8 A tuition waiver may be permitted for a person, at his/her request, who falls under one of the following items, and is found to experience significant difficulty in paying his/her tuition:

(i) Where, within six months prior to the due date of tuition for each semester (or within one year prior to the day of admission in the case where the waiver concerned covers the tuition for the semester to which the day of the relevant admission, readmission, or transfer admission belongs [hereinafter simply referred to as the "day of admission"]), the person who principally bore the educational expenses for the student concerned (hereinafter referred to as the "Educational Expense Payer") dies, or the student concerned, or Educational Expense Payer suffers a disaster such as damage caused by wind or flood (hereinafter referred to as a "disaster"); or

(ii) In cases that are equivalent to the preceding item, and in which substantial grounds are found.

(Tuition eligible for Waiver)

Article 9 The permission for a tuition waiver shall be given in relation to the tuition that is due in the second semester following the semester in which the relevant circumstance arose (or the semester to which the day of admission belongs in the case where such circumstance arose within one year prior to the day of admission); provided, however, that if the timing of occurrence of the relevant circumstance was prior to the due date of the tuition for the ongoing semester, the waiver may also cover the tuition due in this semester in some cases.

(Amount to Be Waived)

Article 10 The amount of tuition to be waived shall be one-third, half, two-thirds, or the full amount of the tuition due for a semester.

(Request for Permission)

Article 11 A person who intends to request permission for a tuition waiver shall submit the documents specified in the following items to the President of the University by the prescribed due date:

(i) A tuition waiver request form.

(ii) A certificate issued by the head of the person's local government pertaining to income;

(iii) A document certifying the death of the Educational Expense Payer (only in the case where the person requests permission for a waiver on the basis of the death of the Educational Expense Payer);

(iv) A disaster-victim certificate issued by the head of the person's local government (only in the case where the person requests permission for a waiver on the basis of having suffered a disaster); and

(v) Other documents regarded as necessary by the President of the University.

(2) Notwithstanding the provision of the preceding Article 5 (1), in cases where a foreign national requests an admission fee waiver, he/she may submit the separately prescribed documents in lieu of the documents prescribed in Items (ii) to (iv) of the preceding Article 5 (1).

(Admission Fee Collection Deferment)

Article 12 For a person who has requested permission for a tuition waiver, the collection of tuition shall be deferred until a decision concerning such request is made.

(Due Date for Those Whose Request for Waiver Is Refused)

Article 13 A person whose request for permission for a tuition waiver was refused, or who has been granted a one-third, half, or two-thirds amount tuition waiver (except those who have requested payment deferment in accordance with the provision of Article 20 (2)), shall pay two-thirds, half, or one-third, or the full amount, whichever is applicable, of his/her tuition for the relevant semester by the day designated, on the day of notice of such refusal or permission, by the University as the date of direct debit.

Section 3 Tuition Waiver for Reasons of Leave of Absence, Death, Expulsion, Withdrawal, Etc.

(Waiver for Reason of Leave of Absence)

Article 14 A person whose leave of absence is permitted or who is ordered to take a leave of absence, and whose first day of such leave is prior to the due date of tuition payment shall be exempted from payment of the amount of tuition obtained by multiplying an amount equivalent to one-twelfth of the annual amount of his/her tuition (hereinafter referred to as the "Calculated Monthly Amount") by the number of months from the month following the month to which the first day of the leave period belongs (or, if the first day of the leave period is the first day of a month, this month) to the month prior to the month to which the last day of the leave period belongs (or, if the last day of the leave period is the last day of a month, this month).

(2) Those who are to have their tuition fees returned pursuant to the provisions of Article 7-2, Paragraph 2 (limited to those who have been granted a leave of absence) shall be deemed to have had their tuition fees deferred pursuant to the provisions of Article 6, and the provisions of the preceding paragraph shall apply mutatis mutandis. (2) Those who receive a refund of tuition pursuant to the provisions of Article 7-2, Paragraph 2 (limited to those who have been granted a leave of absence) shall be deemed to have had their tuition fees deferred pursuant to the provisions of Article 6, and the provisions of the preceding paragraph shall apply mutatis mutandis.

(Waiver for Reasons of Death, etc.)

Article 15 In the event where a student's record of registration at the University is removed due to the fact that he/she has died or disappeared, the full amount of his/her remaining tuition may be waived.

(2) A person whose tuition fees are to be returned pursuant to the provision of Article 7-2, paragraph (2) (limited to a person who has been excluded from the school register due to death or missing) shall be deemed to have had the collection of tuition fees deferred pursuant to the provision of Article 6, and the provision of the preceding paragraph shall apply mutatis mutandis. (2) A person whose tuition fees are returned pursuant to the provision of Article 7-2, paragraph (2) (limited to those who have been removed from the university register due to death or disappearance) shall be deemed to have had tuition fees deferred pursuant to the provision of Article 6, and the provision of the preceding paragraph shall apply mutatis mutandis.

(Waiver for Reason of Expulsion)

Article 16 A person who is expelled for the reason of his/her failure to pay the admission fee or tuition may be exempted from payment of the full amount of his/her remaining tuition.

(Waiver for Reason of Withdrawal during Collection Deferment Period)

Article 17 (1) A person for whom the collection of tuition has been deferred in accordance with the provision of Article 6, a person for whom a deferment of tuition collection has been permitted in accordance with the provision of the following Article 18, or a person for whom monthly installment payment of tuition has been permitted in accordance with the provision of Article 23, and who is permitted to withdraw from the University during the period of such deferment or monthly installment payment may be exempted from payment of the amount of tuition obtained by multiplying the Calculated Monthly Amount by the number of months from the month following the month of withdrawal to the last day of the semester.

(2) (2) Those who are to have their tuition fees returned pursuant to the provisions of Article 7-2, Paragraph 2 (limited to those

who have been permitted to withdraw) shall be deemed to have had their tuition fees deferred pursuant to the provisions of Article 6, and the provisions of the preceding paragraph shall apply mutatis mutandis. (2) Those who are to receive a refund of tuition fees pursuant to the provisions of Article 7-2, Paragraph 2 (limited to those who have been permitted to withdraw) shall be deemed to have had the collection of tuition fees deferred pursuant to the provisions of Article 6, and the provisions of the preceding paragraph shall apply mutatis mutandis

Chapter III Tuition Deferment and Monthly Installment Payment

(Permission for Payment Deferment)

Article 18 The deferment of tuition payment may be permitted for a student, at his/her request, to whom one of the following items applies (in the case where the student concerned has disappeared, at the request of a person acting on behalf of the student):

(i) The student is found to experience difficulty in paying his/her tuition by the prescribed due date due to financial reasons, and also his/her academic performance is regarded as excellent;

(ii) The student is found to experience difficulty in paying his/her tuition by the prescribed due date, since the student or his/her Educational Expense Payer has suffered a disaster;

(iii) The student has disappeared; or

(iv) The student is found to experience difficulty in paying his/her tuition by the prescribed due date because of other unavoidable circumstances.

(Deadline for Deferred Payment)

Article 19 The deadline for deferred tuition payment shall be a day during September designated by the University as the date of direct debit in the case of tuition for the first semester, and a day during March designated by the University as the date of direct debit in the case of tuition for the second semester.

(Request for Permission)

Article 20 (1) A person who intends to request permission for tuition deferment shall submit a tuition deferment request form to the President of the University by the prescribed due date.

(2) Notwithstanding the provision of the preceding Article 20 (1), a person who requested permission for a tuition waiver in accordance with the provision of Article 5 (1), or Article 11 (1), and whose request was refused or who has been granted permission for a one-third, half, or two-thirds amount tuition waiver may request permission for payment deferment within 14 days starting from the day of notice of such refusal or permission.

(Admission Fee Collection Deferment)

Article 21 For a person who has requested permission for tuition deferment, the collection of tuition shall be deferred until a decision concerning such request is made.

(Due Date for Those Whose Request for Deferment Is Refused)

Article 22 A person for whom tuition deferment was not permitted shall pay the tuition for the relevant semester by the day designated, on the day of notice of such refusal, by the University as the date of direct debit.

(Permission for Monthly Installment Payment)

Article 23 Monthly installment payment of tuition may be permitted for a person, at his/her request, who falls under Article 18 (i), (ii) or (iv), and has special circumstances.

(Amount and Due Date for Monthly Installment Payment)

Article 24 The monthly amount of tuition to be paid by a person for whom month installment payment of tuition has been permitted shall be the Calculated Monthly Amount, and the due date for such payment shall be the day designated by the University as the day of monthly direct debit, unless otherwise prescribed; provided, however, that the due date for tuition payment during a period of leave of absence shall be the day prior to the start day of such period of leave.

(Request for Permission)

Article 25 A person who intends to request permission for monthly installment payment of tuition shall submit a monthly installment payment request form to the President of the University by the prescribed due date.

(Admission Fee Collection Deferment)

Article 26 For a person who has requested permission for monthly installment payment of tuition, the collection of tuition shall be deferred until a decision concerning such request is made.

(Due Date for Those Whose Request for Monthly Installment Payment Is Refused)

Article 27 A person for whom monthly installment payment of tuition was not permitted shall pay the tuition for the relevant semester by the day designated, on the day of notice of such refusal, by the University as the date of direct debit.

Chapter IV Revocation of Permission for Tuition Waiver, Deferment, or Monthly Installment Payment

(Revocation of Permission for Waiver)

Article 28 (1) A person who has received permission for a tuition waiver shall promptly notify the President of the University when the ground for the waiver has ceased to exist.

(2) Upon receipt of the notice prescribed in the preceding Article 28 (1), the permission for the tuition waiver shall be revoked.

(3) A person whose permission granted for a tuition waiver is revoked pursuant to the provision of the preceding Article 28 (2) shall immediately pay the amount of tuition obtained by multiplying the Calculated Monthly Amount by the number of months from the month of such revocation to the last month of the semester concerned.

(Revocation of Permission for Payment Deferment or Monthly Installment Payment)

Article 29 (1) A person who has received permission for tuition deferment or monthly installment payment shall promptly notify the President of the University when the ground for the deferment or monthly installment payment has ceased to exist.

(2) Upon receipt of the notice prescribed in the preceding Article 29 (1), the permission for the tuition deferment or monthly installment payment shall be revoked.

(3) A person whose permission granted for tuition deferment is revoked pursuant to the provision of the preceding Article 29 (2) shall immediately pay his/her tuition for the relevant semester.

(4) A person whose permission granted for monthly installment payment of tuition is revoked pursuant to the provision of Article 29 (2) shall immediately pay his/her remaining tuition.

(Revocation of Permission for Waiver Due to the Discovery of Deception)

Article 30 (1) The permission for a tuition waiver shall be revoked if it is found that the recipient of such permission has failed to make notification as prescribed in the provision of Article 28 (1) despite the ground for such waiver having ceased to exist, or that the recipient of such permission gave false details in, or fabricated, the documents that he/she submitted to obtain such permission.

(2) A person whose permission granted for a tuition waiver is revoked pursuant to the provision of the preceding Article 30 (1) shall immediately pay his/her tuition for the relevant semester.

(Revocation of Permission for Payment Deferment or Monthly Installment Payment Due to the Discovery of Deception)

Article 31 (1) The permission for tuition deferment or monthly installment payment shall be revoked if it is found that the recipient of such permission has failed to make notification as prescribed in the provision of Article 29 (1) despite the ground for such deferment or monthly installment payment having ceased to exist, or that the recipient of such permission gave false details in, or fabricated, the documents that he/she submitted in obtaining such permission.

(2) A person whose permission granted for tuition deferment is revoked pursuant to the provision of the preceding Article 31 (1) shall immediately pay his/her tuition for the relevant semester.

(3) A person whose permission granted for monthly installment payment of tuition is revoked pursuant to the provision of Article 31 (1) shall immediately pay his/her remaining tuition.

Chapter V Procedure for Requesting Permission, Etc. for Tuition Waiver, Deferment, or Monthly Installment Payment

(Procedure for Requesting Permission, etc. for Waiver)

Article 32 The permission for a tuition waiver in accordance with the provisions of Article 2 (1) and Article 8, and the revocation of such permission in accordance with the provision of Article 30 (1) shall be decided by the President of the University upon deliberation by the Student Life Support Council.

Article 33 (1) The permission for a tuition waiver in accordance with the provisions of Articles 15 to 17 shall be decided by the President of the University on the basis of an application made by the dean of the undergraduate or graduate school to which the person concerned belongs.

(2) The revocation of permission for a tuition waiver in accordance with the provision of Article 28 (2) shall be decided by the President of the University.

(Procedure for Requesting Permission, etc. for Payment Deferment or Monthly Installment Payment)

Article 34 The permission for tuition deferment or monthly installment payment in accordance with the provision of Article 18, or that of Article 23, respectively, and the revocation of such permission in accordance with the provision of Article 29 (2) or Article 31 (1) shall be decided by the President of the University.

Chapter VI Miscellaneous Provisions

Article 35 In addition to the provisions of these Regulations, other matters necessary for the handling of tuition waiver, deferment, and monthly installment payment shall be prescribed separately.

Supplementary Provision

1. These Regulations shall come into force on May 15, 1973.
2. The Regulations on Handling of Tuition Waiver at Tohoku University (established on April 1, 1955) shall be abolished.
3. Persons who have held permission for tuition waivers, deferment, or monthly installment payment, at the time of enforcement of these Regulations, in accordance with the provisions of the former Regulations, etc. shall be deemed to have received their permission in accordance with the equivalent provisions of these Regulations, respectively.

Supplementary Provision (Revision: May 18, 1976, Rule No. 42)

These Regulations shall come into force on May 18, 1976, and apply on and after April 1, 1976.

Supplementary Provision (Revision: March 15, 1977, Rule No. 19)

These Regulations shall come into force on March 15, 1977.

Supplementary Provision (Revision: April 18, 1978, Rule No. 35)

These Regulations shall come into force on April 18, 1978, and the provisions of the Regulations on Handling of Tuition Waiver, Deferment, and Monthly Installment Payment of Tohoku University Students after revision by these Regulations shall apply on and after April 1, 1978.

Supplementary Provision (Revision: November 17, 1987, Rule No. 65)

These Regulations shall come into force on November 17, 1987.

Supplementary Provisions (Revision: April 1, 1993, Rule No. 80)

1. These Regulations shall come into force on April 1, 1993.
2. Notwithstanding these Regulations, the provisions of Article 5 (1) and Article 24 before revision shall apply until March 31, 1994.

Supplementary Provision (Revision: March 19, 1996, Rule No. 34)

These Regulations shall come into force on April 1, 1996.

Supplementary Provision (Revision: April 1, 2002, Rule No. 29)

These Regulations shall come into force on April 1, 2002.

Supplementary Provision (Revision: January 27, 2010, Rule No. 8)

These Regulations shall come into force on January 27, 2010, and the revised provisions of the Regulations on Handling of Tuition Waiver, Deferment, and Monthly Installment Payment of Tohoku University Students shall apply to persons requesting a tuition waiver, deferment, or monthly installment payment in relation to the first semester of academic year 2010, or subsequent thereto.

Supplementary Provision (Revision: December 7, 2010, Rule No. 99)

These Regulations shall come into force on April 1, 2011.

Supplementary Provision (Revision: April 28, 2015, Rule No. 72)

These Regulations shall come into force on April 28, 2015 and apply on and after April 1, 2015.

Supplementary Provision (Revision: May 8, 2018, Rule No. 107)

1. These Regulations shall come into force on May 8, 2018, and the revised provisions of Article 33 (1) shall apply on and after April 1, 2018.
2. The provisions of Article 33 (1) before revision by these Regulations shall continue to be effective while the Graduate School of Educational Informatics Education Division remains in existence based on Supplementary Provision 2 of the Regulations to Partially Revise Tohoku University Graduate School General Rules (Rule No. 54 of 2018).

Supplementary Provision (Revision: March 24, 2020, Rule No. 15)

These Regulations shall come into force on April 1, 2020.

Supplementary Provisions

1 These regulations shall come into effect on May 8, 2008, and the provisions of Article 33, Paragraph 1 after the revision

shall apply from April 1, 2008.

2 The provisions of Article 33, Paragraph 1 of the Regulations Concerning the Handling of Exemption and Postponement of Collection of Tuition Fees and Monthly Installment Payment for Students of Tohoku University prior to the revision by these regulations shall remain in effect while the Educational Informatics Education Division, which is deemed to continue to exist pursuant to the provisions of Paragraph 2 of the Supplementary Provisions of the General Rules for Partial Revision of the General Rules of Tohoku University Graduate School (Regulation No. 54 of 2008), continues to exist.

Supplementary Provisions

These regulations shall come into effect on April 1, 2020.

Regulations on Handling of Admission Fee Waiver and Deferment at Tohoku University

(Purpose)

Article 1 These Regulations prescribe the handling of admission fee waiver and deferment at Tohoku University (hereinafter referred to as the "University"), on the basis of the provisions of Article 15-2 (2) of the Tohoku University Faculty Regulations (Established on December 18, 1952; hereinafter, the "Faculty Regulations"), and Article 19-2 (3) of the Tohoku University Graduate School Regulations (established on November 16, 1953).

(Permission for Waiver)

Article 2 An admission fee waiver may be permitted for a person, at his/her request, whose admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission to an undergraduate school of the University (hereinafter referred to as "Admission" in this Article 2 and Article 6) has been permitted, and who falls under one of the following items:

(i) A particularly excellent person (meaning the particularly excellent person referred to in Article 8, Paragraph 1 of the Act on Support for Study at Universities, etc. [Act No. 8 of 2019]) who is found to experience significant difficulty in studying due to financial reasons; or

(ii) A person who is found to experience significant difficulty in paying his/her admission fee for the reason that, within one year prior to the Admission, the person who principally bore the educational expenses for the admitted person (hereinafter referred to as the "Educational Expense Payer") died, or the admitted person or Educational Expense Payer suffered a disaster such as damage caused by wind or flood (hereinafter referred to as a "disaster"), or for any other similar reason.

Article 3 (1) An admission fee waiver may be permitted for a person, at his/her request, whose admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission to a graduate school of the University (Hereinafter referred to as "Graduate School Admission" in the following Article 3 (2) and Article 6) has been permitted, who is found to experience difficulty in paying his/her admission fee due to financial reasons, and whose academic performance of such person is regarded as excellent.

(2) In addition to the persons prescribed in the preceding Article 3 (1), an admission fee waiver may be permitted for a person, at his/her request, whose Graduate School Admission has been permitted, and who falls under Item (ii) of the preceding Article 2.

(Amount to Be Waived)

Article 4 The amount of the admission fee to be waived shall be one-third, half, two-thirds, or the full amount thereof.

(Request for Waiver Permission)

Article 5 (1) A person who intends to request permission for an admission fee waiver in accordance with the provision of Articles 2 or 3 shall submit the documents specified in the following items to the President of the University by the prescribed due date:

(i) An admission fee waiver request form.

(ii) A certificate issued by the head of the person's local government pertaining to income.

(iii) A document certifying the death of the Educational Expense Payer (only in the case where the person requests permission for a waiver on the basis of the death of the Educational Expense Payer);

(iv) A disaster-victim certificate issued by the head of the person's local government (only in the case where the person requests permission for a waiver on the basis of having suffered a disaster); and

(v) Other documents regarded as necessary by the President of the University.

(2) Notwithstanding the provision of the preceding Article 5 (1), in cases where a foreign national requests an admission fee waiver, he/she may submit the separately prescribed documents in lieu of the documents prescribed in Items (ii) to (iv) of the preceding Article 5 (1).

(Permission for Payment Deferment)

Article 6 The deferment of payment of the admission fee may be permitted for a person, at his/her request, whose Admission or Graduate School Admission has been permitted, and also who falls under one of the following items:

(i) Where it is regarded as difficult to collect the person's admission fee by the prescribed due date due to financial reasons, and the academic performance of the person is regarded as excellent.

(ii) Where, within one year prior to the Admission or Graduate School Admission, the relevant Educational Expense Payer dies, or the person concerned with the permitted Admission or Graduate School Admission, or the relevant Educational Expense Payer suffers a disaster; or

(iii) Where other unavoidable circumstances are found to exist.

(Deadline for Deferred Payment)

Article 7 The deadline for deferred admission fee payment shall be September 15 for those enrolling in April, and March 15 for those enrolling in October.

(Request for Permission for Payment Deferment)

Article 8 (1) A person who intends to request permission for admission fee deferment shall submit an admission fee deferment request form to the President of the University by the prescribed due date.

(2) Notwithstanding the provision of the preceding Article 8 (1), a person who requested permission for an admission fee waiver in accordance with the provision of Article 5, and whose request has been refused or who has been granted permission for a half amount admission fee waiver may request permission for payment deferment within 14 days starting from the day of notice of such refusal or permission.

(Admission Fee Collection Deferment)

Article 9 For a person who has requested permission for an admission fee waiver or deferment, the collection of the admission fee shall be deferred until a decision concerning such request is made (excluding cases where a person who has made the application referred to in Article 9, Paragraph 1 of the Regulation for Enforcement of the Act on Support for Study at Universities, etc. [Order of the Ministry of Education, Culture, Sports, Science and Technology No. 6 of 2019] had already paid his/her admission fee).

(Due Date for Those Whose Request for Waiver Is Refused, etc.)

Article 10 A person whose request for permission for an admission fee waiver or deferment was refused, or who has been granted permission for a one-third, half, or two-thirds amount admission fee waiver (except those who have requested payment deferment in accordance with the provision of Article 8 (2) and those who had already paid their admission fees), shall pay the full amount, or if applicable the two-thirds, half, or one-third amount, of his/her admission fee within 14 days starting from the day of notice of such refusal or permission.

(Refunding of Admission Fee)

Article 11 (1) Notwithstanding the provision of Article 16 (1) of the Faculty General Rules, among persons who have been granted permission for an admission fee waiver, for a person who had already paid his/her admission fee, the amount equivalent to the waived amount shall be refunded from the amount of such admission fee.

(2) In addition to the person prescribed in the preceding Article 11 (1), among persons who have requested an admission fee waiver, for a person who had already paid his/her admission fee and who dies before a decision concerning such request is made, the amount equivalent to the amount of his/her admission fee waived in accordance with the provision of the following Article 12 (1), which applies mutatis mutandis in Article 12 (2), shall be refunded from the amount of such admission fee.

(Waiver for Reason of Death, etc.)

Article 12 (1) In the event where a person who has requested an admission fee waiver or deferment dies during the period of deferment of his/her admission fee payment, the full amount of his/her remaining admission fee shall be waived.

(2) For a person to whom his/her admission fee is to be refunded in accordance with the provision of the preceding Article 11 (2), the collection of such admission fee shall be deemed to be deferred in accordance with the provision of Article 9, and the provision of the preceding Article 12 (1) shall apply mutatis mutandis.

Article 13 In the event where a person whose request for an admission fee waiver or deferment was refused, or who has been granted permission for a one-third, half, or two-thirds amount admission fee waiver dies prior to his/her payment of the admission fee, the full amount of his/her remaining admission fee shall be waived.

(Waiver For Reasons of Expulsion, etc.)

Article 14 A person who is expelled for the reason of his/her failure to pay the admission fee shall be exempted from payment of the full amount of his/her remaining admission fee.

(Revocation of Permission for Waiver, etc. Due to the Discovery of Deception)

Article 15 (1) If it is found that a person obtained permission for an admission fee waiver or deferment by giving false details in, or by fabricating, the documents that he/she submitted, the permission for his/her waiver or deferment shall be revoked.

(2) A person whose granted permission for an admission waiver or deferment is revoked pursuant to the provision of the preceding Article 14 (1) shall immediately pay his/her admission fee.

(Procedure for Requesting Permission, etc. for Waiver)

Article 16 The permission for and revocation of an admission fee waiver shall be decided by the President of the University upon deliberation by the Student Life Support Council.

(Procedure for Requesting Permission, etc. for Deferment)

Article 17 The permission for and revocation of admission fee deferment shall be decided by the President of the University.

(Miscellaneous Provisions)

Article 18 In addition to the provisions of these Regulations, other matters necessary for the handling of admission fee waiver and deferment shall be prescribed separately.

Supplementary Provision

These Regulations shall come into force on March 15, 1977.

Supplementary Provision (Revision: March 17, 1987, Rule No. 15)

These Regulations shall come into force on March 17, 1987.

Supplementary Provision (Revision: November 17, 1987, Rule No. 64)

These Regulations shall come into force on November 17, 1987.

Supplementary Provisions (Revision: April 1, 1993, Rule No. 79)

1. These Regulations shall come into force on April 1, 1993.
2. Notwithstanding these Regulations, the provisions of Article 6 (1) and Article 16 (1) before revision shall apply until March 31, 1994.

Supplementary Provision (Revision: March 19, 1996, Rule No. 34)

These Regulations shall come into force on April 1, 1996.

Supplementary Provisions (Revision: April 16, 1996, Rule No. 55)

1. These Regulations shall come into force on April 16, 1996.
2. The revised provision of Article 3 shall apply to persons for whom admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission to graduate schools in academic year 1996 or later is permitted.

Supplementary Provision (Revision: April 1, 2002, Rule No. 28)

These Regulations shall come into force on April 1, 2002.

Supplementary Provision (Revision: February 18, 2003, Rule No. 4)

These Regulations shall come into force on April 1, 2003, and the revised provisions of the Regulations on Handling of Admission Fee Waiver and Deferment at Tohoku University shall apply to persons for whom admission, readmission (limited to readmission at the beginning of the first semester), or transfer admission to undergraduate schools, or a transfer to other undergraduate schools (limited to transfers from undergraduate schools other than the School of Medicine or the School of Dentistry to the School of Medicine or the School of Dentistry) in academic year 2003 or later is permitted, and to those for whom admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission to graduate schools or the Education Division in academic year 2003 or later is permitted.

Supplementary Provision (Revision: December 21, 2004, Rule No. 338)

These Regulations shall come into force on December 21, 2004, and the revised provisions of the Regulations on Handling of Admission Fee Waiver and Deferment at Tohoku University shall apply to persons for whom admission, readmission (limited to readmission at the beginning of the first semester), or transfer admission to undergraduate schools in academic year 2005 or later is permitted.

Supplementary Provision (Revision: January 27, 2010, Rule No. 7)

These Regulations shall come into force on January 27, 2010, and the revised provisions of the Regulations on Handling of Admission Fee Waiver and Deferment at Tohoku University shall apply to persons for whom admission, readmission (limited to readmission at the beginning of the first or second semester), or transfer admission to undergraduate schools, graduate schools, or the Education Division in academic year 2010 or later is permitted.

Supplementary Provision (Revision: April 28, 2015, Rule No. 72)

These Regulations shall come into force on April 28, 2015, and apply on and after April 1, 2015.

Supplementary Provision (Revision: May 8, 2018, Rule No. 106)

These Regulations shall come into force on May 8, 2018, and the revised provisions of Article 3 (1) shall apply on and after April 1, 2018.

Supplementary Provision (Revision: March 24, 2020, Rule No. 14)

These Regulations shall come into force on April 1, 2020.

Tohoku University Engineering Library Usage Rules

Enacted January 8, 1979
Revised December 19, 1980
Revised April 21, 1982
Revised July 11, 1984
Revised July 23, 1990
Revised April 20,1992
Revised October 16, 1997
Revised July 3, 2001
Revised January 8,2004
Revised June 18, 2009

Chapter 1 General Regulations

(Purport)

Article 1 The Tohoku University Engineer Library (hereafter "the library") is governed by these regulations, except where otherwise specified.

(Scope of service)

Article 2 Usage of the Library is defined as access to Library materials, borrowing Library materials, copying materials, inter-departmental/library use, and usage of information services etc. regarding materials.

(Scope of users)

Article 3 Persons who may use the library are Tohoku University (hereafter, "this University") instructors, researchers, trainees, graduate students and undergraduate students (including research students, non-degree students, and inter-university credit exchange students), and, upon application, non-university persons.

(Library hours)

Article 4 Library hours are as follows.

However, the Director of the Library may change these hours if deemed necessary; such changes will be announced on a case-by-case basis.

Mon. through Fri., 9:00AM to 8:00PM (Days closed)

Article 5 The Library is closed on the following days.

(1) Sunday
(2) Saturday
(3) National holidays, as stipulated by the National Holidays Act (Law No. 178, 1948)
(4) Anniversary of the founding of this University (22nd of June)
(5) Winter holiday (December 25 to January 3 of the following year)
(6) Other's days, as deemed necessary by the Director of the Library

(Usage procedure)

Article 6 Those wishing to use the library must obtain a library card (includes student ID and identification cards issued by Tohoku University) in advance.

Library users must bring their library card when entering the library, and must present it upon request by library staff (hereafter, "Staff").

Temporary, non-university users must submit a Non-university User Form.

Chapter 2 Access to Library Materials

Article 7 Those wishing to access library materials (hereafter "materials") may freely search and access materials, except for persons specially designated by the Library Director.

(Limitations on access)

2 Access to materials may be subject to restrictions in the following cases.

(1) In the event that Library materials are deemed to contain information that falls under the purview of the Law on the Disclosure of Information in the Possession of Independent Administrative Corporations (2001 Law No. 140,

hereafter "Information Disclosure Law") Article 5 Nos. 1, 2 and 4b, access to the portions of those materials that contain said information shall be restricted.

(2) In the event that the library receives a contributed item or is entrusted with an item from an individual or corporation pursuant to the Information Disclosure Law Article 5 No.2, under the condition that said item is not to be made publicly available for a specified amount of time, access to said item shall be restricted.

(3) Access shall be restricted for originals that are susceptible to damage or staining, or for items that are currently in use.

3 In order to facilitate access to materials by users, a catalog of materials and a copy of these regulations shall be always kept in the reading room.

(Access to special materials)

Article 8 Persons specially designated by the Library Director who wish to access materials must complete the prescribed procedure.

Chapter 3 Borrowing from the Library

Article 9 Only university users may borrow materials from the library.

2 Persons who wish to borrow materials from the library must complete the prescribed procedure.

(Non-borrowable materials)

Article 10 Degree dissertations, magazines, newspapers, audio-visual materials, materials labeled as non-borrowable, and materials the loan of which is deemed inappropriate by the Library Director, cannot be borrowed.

2 Regardless of the previous item, in some cases the above materials may be borrowed if the Library Director deems there is sufficient reason.

(Borrowing limit, due date etc.)

Article 11 Except where otherwise specified, instructors and graduate students may borrow a maximum of 10 items, undergraduate students 5 items, for up to two weeks.

(Reserving materials)

Article 12 Persons who wish to borrow materials currently on loan to someone else may reserve those materials.

(Responsibilities of borrowers)

Article 13 Borrowers are responsible for materials they have borrowed until they return them to the Library.

2 Borrowers must not lend materials they have borrowed to other people.

(Returning borrowed materials)

Article 14 Borrowers must return materials they have borrowed by the due date.

2 Persons who have lost borrowing privileges must immediately return materials they have borrowed.

3 The Library Director may recall borrowed materials at any time, even before the due date, if deemed necessary.

(Suspension of borrowing privileges)

Article 15 Persons who fail to return borrowed materials by the due date may have their borrowing privileges suspended as follows:

(1) Persons who have overdue materials may not borrow new materials, even if they have not exceeded their limit.

(2) When returning materials after the due date, no subsequent materials may be borrowed. 2 Regardless of the previous item, in some cases the above restrictions on borrowing may be altered if the Library Director deems there is a sufficient reason for doing so.

(Long-term borrowing)

Article 16 Persons responsible for materials in their departments (hereafter, "Responsible Parties") at the undergraduate and graduate Schools of Engineering, Graduate School of Information Sciences, Graduate School of Environmental Studies, Graduate School of Biomedical Engineering, and New Industry Creation Hatchery Center (hereafter, "School of Engineering etc.") may arrange to borrow materials long-term by completing the prescribed procedures.

2 Materials that are eligible for long-term borrowing are those that have been purchased or donated using administrative cost subsidies or research subsidies by Responsible Parties in the departments listed above.

3 Storage of materials borrowed long-term is the responsibility of the Responsible Parties. (Usage exceptions for long-term borrowing)

Article 17 So long as it poses no obstructions, departments borrowing materials long-term shall allow them to be accessed or borrowed by other users.

Chapter 4 Copying documents

(Requesting copies)

Article 18 Persons who wish to copy materials my request copies by completing the prescribed procedure. However, persons wishing to copy or image materials themselves must obtain prior permission from the Library Director.

(Request procedure)

Article 19 Procedures and fees for requesting copies of documents are described in the "Tohoku University Library Regulations on Document Copying" (1967 Reg. 28; Revised April 1, 1999 Reg. 72).

(Copy-restricted materials)

Article 20 Requests to copy or image etc. materials will not be honored if doing so would infringe on copyright laws or if deemed inappropriate by the Library Director

2 When copying documents, the party who requested the copy shall bear all responsibilities concerning copyright.

Chapter 5 Inter-departmental Use

(Use of materials from other departments)

Article 21 Materials possessed by this University can be shared among departments through the agreed upon procedures.

(Copying university documents)

Article 22 The copying of materials from other departments shall be carried out as described in the "Implementation Guidelines for the Tohoku University Inter-Library (Office) Document Copying Service."

Chapter 6 Inter-Library Use

(Using libraries at other universities)

Article 23 The Library may handle requests to use materials at other public research institutes (national and public universities, or the National Diet Library etc.) from persons belonging to the School of Engineering etc.

2 Persons who make the above-described requests shall bear any necessary fees.

(Loan of originals)

Article 24 The Library may handle requests to borrow materials from other public research institutes (national and public universities, or the National Diet Library etc.) from persons belonging to the School of Engineering etc.

2 Persons who make the above-described requests shall bear any necessary fees.

(Copying non-university documents)

Article 25 The Library may handle requests to copy documents at other public research institutes (national and public universities, or the National Diet Library etc.) from persons belonging to the School of Engineering etc.

2 Persons who make the above-described requests shall bear any necessary fees.

Chapter 7 Reference Surveys

(Reference survey request)

Article 26 Persons who wish to request reference research on literature, etc. for the purpose of education or research may do so.

(Scope of reference survey)

Article 27 The scope of the reference survey shall be as follows:

(1) Academic document bibliographies, surveys of location information.

(2) Survey on a specific item or reference document referral.

(3) Information on usage of libraries at this University, or at other universities or research institute facilities.

(4) Other

2 Regardless of the previous provision, requests for reference surveys shall not be honored if it is thought that the proposed survey will require large amounts of money or time, or obstruct other services, or if the Library Director deems it inappropriate.

Chapter 8 Use of Library Facilities

Article 28 Persons who wish to use the Audio-Visual Room may do so by completing the prescribed procedure.
2 The prescribed procedure shall be specified elsewhere.

Chapter 9 Penalties

(Reimbursement)

Article 29 Those who damage or lose materials they are using must provide an identical replacement, or pay an equivalent reimbursement.

(Restriction of usage privileges)

Article 30 Those who violate these usage rules may have their usage privileges limited or suspended.

(Measures to prevent the leakage of personal information)

Article 31 When *personal information is recorded in books, the following measures shall be taken to prevent the leakage of such personal information. *Personal information such as; Information about a living individual that can identify a specific person by name, date of birth, or other description contained in the information, Information that can be cross-checked with other information to identify a specific person.

(Mutatis mutandis application)

Article 32 The "Tohoku University Library Regulations" shall apply mutatis mutandis for other usages not specified by these regulations.

Chapter 10 Supplementary Rules

Article 33 Items necessary to Library usage not included in these regulations shall be specified separately.

Supplementary Regulations 1 These regulations became effective as of April 1, 1979.

2 The Tohoku University Central Engineering Library Usage Guide (April 1976) is hereby abolished.

3 Revision and elimination of these regulations shall be performed via discussion by the Engineering Library Operating Committee.

Supplementary Regulation (Revised December 19, 1980-Revised January 8, 2004)

Supplementary Regulation (Revised June 18, 2009)

These regulations were passed on April 1, 2009, and became effective as of June 18, 2009.

Guidelines for Students of the Tohoku University School of Engineering on Handling of Accidents

Article 1 Purpose and Administrative Precautions

1 These guidelines are given for the purpose of achieving uniform and smooth response in case of death or personal injury, theft, fire, natural disasters, property damage (including vandalism), or similar accidents (hereinafter “accident”) occurring on the premises of the School of Engineering (includes undergraduate and graduate schools, and the New Industry Creation Hatchery Center) when the first respondent is a student or a research student in the School of Engineering etc. (hereinafter “student”).

2 If an accident occurs on the premises of the School of Engineering, students must take appropriate action in accordance with the guidelines given in the Tohoku University Accident Handling Guidelines for Students.

3 In carrying out these guidelines, first priority is to be given to human life, while also taking care to prevent disruption to the university functions of research and education.

Article 2 Fire

If a student witnesses a fire, the student shall activate the nearest fire alarm, alert persons in classrooms and laboratories in the vicinity with a loud voice, and immediately notify the fire department. When it is possible to do so safely, the student shall cooperate with school personnel and other students in taking measures to extinguish the fire and prevent damage from spreading. The student shall also promptly notify the nearest administrative office or security guard office (dial 4631 or 5840 on campus).

Article 3 Personal Injury or Death

If a student witnesses an accident involving death or injury, the student shall immediately call a doctor or ambulance and take first-aid measures. The student shall also promptly notify the nearest administrative office or security guard office (dial 4631 or 5840 on campus).

Article 4 Property Damage

If a student witnesses a property damage accident or causes such an accident, the student shall promptly notify school personnel as well as the nearest administrative office or security guard office (dial 4631 or 5840 on campus).

Article 5 Theft or Robbery

If a student discovers the scene of a theft or robbery, or is the victim of such a crime, the student shall promptly notify the nearest administrative office or security guard office (dial 4631 or 5840 on campus).

Article 6 Notification to Police

When a student witnesses an accident that is or may be a threat to life or limb, and judges.

Tohoku University Komei-kai Association

Established on June 25, 1985
Latest revision May 10, 2017

(Title)

Article 1 The name of this society shall be Tohoku University Komei-kai.

(Purpose)

Article 2 The purpose of this association is to promote mutual friendship among the members and to improve the life of the school.

(Project)

Article 3 In order to achieve the purpose of the preceding article, the Society shall conduct the following activities with the grant from Aoba Industrial Association.

(1) Holding a welcome party for new students
(2) Organizing Sports Day and Sports Festival
(3) Other activities to achieve the objectives of the Society

(Member)

Article 4 The Society shall be organized by the members listed in the following table.

Classification	Person concerned
Student Members	(1) School of Engineering Students (2) Graduate School of Engineering Students (3) Graduate School of Information Sciences Students (4) Graduate School of Environmental Studies Students (5) Graduate School of Biomedical Engineering Students (6) Research students and non-degree students enrolled in training institutes and other departments that organize the Graduate School of Engineering, Graduate School of Information Sciences, Graduate School of Environmental Studies, and Graduate School of Biomedical Engineering
Teacher Members	(1) Full-time teacher at the Graduate School of Engineering (2) Full-time teacher at the Graduate School of Information Sciences (3) Full-time teacher at the Environmental Studies (4) Full-time teacher at Graduate School of the Biomedical Engineering (5) Full-time teacher who belong to departments, etc. of training institutes, etc. that organize the Graduate School of Engineering, Graduate School of Information Sciences, Graduate School of Environmental Studies and Graduate School of Biomedical Engineering
Support Members	(1) School of Engineering, etc. (including the Engineering Branch of the Library) Staff (excluding Teacher) (2) A person who agrees with the purpose of this association, wishes to become a member, and has been approved for membership.

(Officers)

Article 5 The Society shall have the officers listed in the following table.

Classification	Numbers of members	Matters under one's jurisdiction	Method of operation
President	One person	He/she shall represent the Society and preside as the President of the Society.	The Dean of the Graduate School of Engineering (Dean of the School of Engineering) shall be appointed.
Vice President	Several people	Assist the President and perform the President's duties on his/her behalf when the President is unable to do so.	Appointed by the President from among the Teacher members.
Advisor	Several people	To participate in the management of the Society.	Appointed by the President from among the Teacher members.
Director	Several people	To participate in the management of the Society.	The members shall be the Teacher members recommended by the departments in Appendix 1 and the administrative director of the School of Engineering and the Graduate School of Engineering and shall be appointed by the President.
Participation	Several people	To provide assistance and cooperation in the implementation and operation of the Society's projects.	Section chiefs belonging to the administrative divisions of the School of Engineering and the Graduate School of Engineering (including the section chiefs of the Engineering Branch of the Library) Clerical staffs above (excluding the head of the clerical department of the School of Engineering) The President shall appoint a member of the administrative staff of the School of Engineering and the Graduate School of Engineering (including the head of the Engineering Branch of the Library) or higher (excluding the head of the administrative department of the School of Engineering and the Graduate School of Engineering) and a staff member of the Aoba Industrial Association.

2 Officers (excluding officers assigned by position designation) The same shall apply hereinafter.) The term of office of the officers (excluding officers assigned by designation) shall be from April 1 to March 31 of the following year. However, the term of office of a substitute officer shall be the remaining term of office of his/her predecessor.

3 The officers in the preceding paragraph may be reappointed.

(Board of Directors)

Article 6 The Society shall have a Board of Directors as the voting body of the Society.

2 The Board of Directors shall consist of the President, Vice President, Advisors and Directors (hereinafter referred to as "Members").

3 The Board of Directors shall deliberate and decide on the matters listed in the following items

(1) Business Plan

(2) Revision of the constitution

(3) Other important matters related to the operation of the Society

4 The Board of Directors shall be convened by the President and the President shall preside.

5 A meeting of the Board of Directors may not be held, and a resolution may not be made unless one-half or more of the members are present.

6 The agenda of the Board of Directors shall be decided by a majority vote of the members present, and in the event of a tie vote, the President shall decide.

7 The President may, when he/she deems it necessary, have a person other than a member attend the Board of Directors meeting to express his/her opinions.

(Board of Advisors and Directors)

Article 7 The Society shall establish a Board of Advisors and Managers to consider the matters listed in the following items.

(1) Planning of business plans, etc. to be submitted to the Board of Directors

(2) Important matters concerning the implementation of the project

(3) Other matters as requested by the President

2 The Board of Advisors and General Managers shall consist of the Advisors and officers designated by the President, as well as the Managers and Vice Managers of each division as specified in Article 8, Section 2.

3 A meeting of the Board of Advisors and Managers shall be convened and chaired by an Advisor of the General Affairs Department designated in advance by the President.

(All parts)

Article 8 The following departments (hereinafter referred to as "Departments") of the Society shall be responsible for implementing the business of the Society. The Society shall establish the following departments (hereinafter referred to as "Departments").

Classification	Projects and Matters under the Jurisdiction
General Affairs Department	Matters related to overall planning, liaison, and coordination for the implementation of the Society's projects. Management of the Sports Day.
Sports Department	Organization of athletic meets and sports competitions, mainly related to the management of these events.

2 Each department shall have a director, a vice director, and members of the undergraduate and graduate student sections (hereinafter referred to as "directors, etc.") as listed in the following table. Each Division shall have a Director, Vice Directors, and members of the Undergraduate Student Division and the Graduate Student Division (hereinafter referred to as "Directors, etc.") as listed in the following table, who shall be appointed by the Student Members.

Classification	Numbers of members	Matters under one's jurisdiction	Method of operation
Director	One person	Represent the relevant department and take charge of the business and matters under the jurisdiction of the relevant department.	The members of the club shall be elected from among the fourth-year School of engineering students belonging to the club.
Vice director	One person	Assists the head of the department in question and performs the duties of the head of the department on his or her behalf when the head is unable to do so.	The members of the club shall be elected by the members of the third-year School of engineering students who belong to the club.

Member	Several people	Handles the business and matters under the jurisdiction of the relevant department.	They shall be elected as specified in Appendix 2.
Student Participation	Several people	Provide advice and guidance as appropriate based on their experience for the smooth implementation of the Society's projects.	Appointed by the Advisor as necessary.

3 The term of office of the director, vice director, and members of the faculty shall be from April 1 to March 31 of the following year, and reappointment shall not be precluded. However, the term of office of substitute directors, vice directors, and members of the faculty shall be the remaining term of office of their predecessors.
4 The term of office for graduate student members shall be from April 1 to the end of the athletic meet of the relevant year.

(Director's Meeting, Executive Committee)
Article 9 As a consultative body for the smooth implementation of the projects and matters under the jurisdiction of each department, there shall be a committee of department heads, all department members, and a committee of department members of each department as listed in the following table (" Committee of Department Heads ").

Classification	Composition	Method of operation
Board of directors	General manager and deputy general manager of each department	The General Manager of the General Affairs Department shall convene the meeting as necessary, and the General Manager shall act as President.
Joint committee of the whole club	General manager, vice general manager, and members of each department	The General Manager of the General Affairs Department shall convene the meeting as necessary, and the General Manager shall act as President.
Committee of each section	The General Manager of the General Affairs Department shall convene the meeting as necessary, and the General Manager shall act as President.	The general manager of the relevant department shall convene the meeting as necessary, and the general manager of the relevant department shall act as President.

2 Details concerning the operation of the Committee of Department Heads, etc. shall be determined by the Committee of Department Heads.
3 If it is difficult for the department to carry out the project or matter under its jurisdiction alone, it may form an executive committee to carry it out.
4 The establishment, organization and operation method of the Executive Committee shall be decided through consultation with the General Managers' Meeting.
5 Advisors, counselors, and other officers may attend the General Managers' Meeting and the Executive Committee and provide advice, etc.

(Miscellaneous rules)
Article 10 In addition to what is provided for in this Constitution, matters necessary for the operation of the Society shall be determined by the President.

Supplementary Provision
1 This constitution shall come into effect as of July 1, 1985.
2 The Constitution of the Engineering Advancement Association of Tohoku University (enacted on September 27, 1919) shall be abolished.

3 At the time of enforcement of this constitution, transitional measures concerning members and officers based on the existing Tohoku University Komei-kai constitution (enacted on September 27, 1919) shall be determined separately by the President.

Supplementary Provision (Amended on June 4, 1997)

This Constitution shall come into effect on June 4, 1997, and the revised Article 4, Article 5 (except for the section on the Graduate School of Information Science in Appendix 1) shall come into effect on the same date. The revised Article 4, Article 5 (excluding the section on the Graduate School of Information Science and Technology in Appendix 1), and Article 8 shall apply from April 1, 1997.

Supplementary Provision (Amended on May 6, 1998)

This constitution shall come into effect on May 6, 1998, and shall apply from April 9, 1998.

Supplementary Provision (Amended on May 7, 2003)

This constitution shall come into effect on May 7, 2003, and shall apply from April 1, 2003.

Supplementary Provision (Amended on May 6, 2004)

1 This constitution shall come into effect on May 6, 2004, and shall apply from April 1, 2004.

2 The revision of Appendix 2 shall apply to students entering in 2004.

Supplementary Provision (Amended on May 11, 2005)

This constitution shall come into effect on May 11, 2005, and shall apply from April 1, 2005.

Supplementary Provision (Amended on February 25, 2008)

This constitution shall come into effect on April 1, 2008.

Supplementary Provision (Amended on May 13, 2009)

This constitution shall come into effect on May 13, 2009.

Supplementary Provision (Amended on May 9, 2012)

This constitution shall come into effect on May 9, 2012.

Supplementary Provision (Amended on May 8, 2013)

This constitution shall come into effect on May 8, 2013.

Supplementary Provision (Amended on May 13, 2015)

This constitution shall come into effect on May 13, 2015, and shall apply from April 1, 2015.

Supplementary Provision (Amended on May 11, 2016)

This constitution shall come into effect on May 11, 2016, and shall apply from April 1, 2016.

Supplementary Provision (Amended on May 10, 2017)

This constitution shall come into effect on May 10, 2017, and shall apply from April 1, 2017.

Appendix 1: Majors, etc., in which directors are elected

Name of major, etc.	
Graduate School of Engineering	Mechanical Systems Engineering
	Fine mechanics
	Robotics
	Aerospace Engineering
	Quantum Science and Energy Engineering
	Electrical Engineering
	Communications Engineering
	Electronic Engineering
	Applied Physics
	Applied Chemistry
	Chemical Engineering
	Biomolecular Engineering
	Metallurgy
	Materials Science
	Materials Processing
	Civil and Environmental Engineering
	Architecture and Building Science
	Management Science and Technology
Graduate School of Information Sciences	Computer and Mathematical Sciences
	System Information Sciences
	Human-Social Information Sciences
	Applied Information Sciences
Graduate School of Environmental Studies	Department of Environmental Studies for Advanced Society
	Department of Frontier Sciences for Advanced Environment; Eco-materials and Processing
	Department of Frontier Sciences for Advanced Environment; Applied Environmental Chemistry
	Department of Frontier Sciences for Advanced Environment; Cultural Environmental Studies
Graduate School of Biomedical Engineering	Biomedical Engineering
Division, etc., organizing the Graduate School of Engineering at the Institute for Materials Research	
Institute of Fluid Science	
Institute of Electrical Communication	
Division, etc., organizing the Graduate School of Engineering at the Institute of Multidisciplinary Research for Advanced Materials	

Appendix 2 (1) Departments of Undergraduate Student Members. Number of students per academic year

Department name, etc.	Fourth-year student	Third-year student
Mechanical and Aerospace Engineering	2 people	2 people
Electrical, Information and Physics Engineering	2 people	2 people
Applied Chemistry, Chemical Engineering and Biomolecular Engineering	1 person	1 person
Materials Science and Engineering	1 person	1 person
Civil Engineering and Architecture	1 person	1 person

* For second-year undergraduates, the representative of each class attends various meetings as needed to communicate with students about Komei-kai events.

(2) Election of graduate student club members and assignment to athletic clubs

Name of major, etc.		Summary
Graduate School of Engineering	Mechanical Systems Engineering Fine mechanics Robotics Aerospace Engineering Quantum Science and Energy Engineering Electrical Engineering Communications Engineering Electronic Engineering Applied Physics Applied Chemistry Chemical Engineering Biomolecular Engineering Metallurgy Materials Science Materials Processing Civil and Environmental Engineering Architecture and Building Science Management Science and Technology	One member from each of the majors listed on the left shall be selected to serve as the caretaker of each team.
Graduate School of Information Sciences	Computer and Mathematical Sciences System Information Sciences Human-Social Information Sciences Applied Information Sciences	One member from each of the majors listed on the left shall be selected to serve as the caretaker of each team.
Graduate School of Environmental Studies	Department of Environmental Studies for Advanced Society Department of Frontier Sciences for Advanced Environment; Eco-materials and Processing Department of Frontier Sciences for Advanced Environment; Applied Environmental Chemistry Department of Frontier Sciences for Advanced Environment; Cultural Environmental Studies	One member of each club shall be selected from each course to serve as the caretaker for each team.
Graduate School of Biomedical Engineering	Biomedical Engineering	One member from each of the majors listed on the left shall be selected to serve as the caretaker of each team.

Aoba Kogyo-kai Association

Chapter I General Provisions

Article 1 The name of this association is Aoba Kogyo-kai (Tohoku University Engineering Alumni Association).

Article 2 The office of the Society shall be located at 6-6 Aoba, Aramaki Aza, Aoba-ward, Sendai-city, in the Graduate School of Engineering, Tohoku University.

Article 3 The purpose of the Society is to promote friendship among its members, to contribute to the progress and development of Japanese industry, and to promote the interests of future generations.

Article 4 In order to achieve the purpose of the preceding article, the Society shall carry out the following activities.

(1) Publication of bulletins, newsletters, and membership lists
(2) Collection, research, and publication of information and materials related to industry
(3) Holding lectures, talks, and other gatherings
(4) Projects of the members and assistance to the School of Engineering, Tohoku University
(5) Other projects necessary to achieve the objectives of the Society

Article5 The Society may establish chapters as separately specified.

Article6 In order to achieve the objectives of the Society, special organizations may be established.

ChapterII Member

Article7 The membership of the Society shall be as follows:

(1) Regular member (2) Special Member (3) Honorary Member (4) Supporting member (5) Student Member

Article8 Regular members shall be those who have graduated from or completed the following schools, current teachers, and those approved by the Board of Directors.

(1) Sendai technical high school
(2) Engineering Specialized Department of Tohoku Imperial University
(3) School of Engineering Tohoku Imperial University
(4) Sendai National College of Technology
(5) School of Engineering Tohoku University
(6) Graduate School of Engineering Tohoku University
(7) Teacher’s training school of Engineering Tohoku University

Article9 Special members shall be former teachers (instructors) of the schools listed in the preceding article and persons approved by the Board of Directors.

2. Honorary members shall be those who have held the position of dean or president of the schools listed in the preceding article, and those who have made outstanding contributions to the Society and have been approved by the Board of Directors.
3. Supporting members shall be corporations or individuals who agree with the objectives of the Society and provide significant support, and who have been approved by the Board of Directors.
4. Student members shall be those enrolled in the School of Engineering and the Graduate School of Engineering.

ChapterIII Board members and others

Article10 The Society shall have the following officers.

(1) President (1 person)
(2) Vice President (Several people)
(3) Director (Several people)
(4) Supervisor (2 people)

Article11 The President shall be the Dean of the School of Engineering, Tohoku University.

2. The Vice President shall be elected by the General Assembly from among the Regular Members and Special Members.
3. The President, Vice- President, and District Branch Managers shall be Directors, and other Directors shall be elected as otherwise provided.

4. Auditors shall be elected by the General Assembly from among regular members and special members.
5. The term of office of the Vice President, Directors, and Auditors shall be 2 years. However, they may not be reappointed.
6. In the event of a vacancy in the office of an officer, the Standing Committee shall elect the officer. However, the term of office shall be the remaining term of the predecessor.

Article12 The President shall represent the Society and manage the affairs of the Society.
2. The Vice- President shall assist the President and represent the President in the event that the President is unable to perform his/her duties.
3. The directors shall handle the affairs of the association.
4. The auditors shall audit the accounts.

Article13 The Society may have advisors.
2. Advisors shall be elected by the Board of Directors from among the members who have rendered distinguished service to the Society.
3. The Advisor may attend meetings of the Board of Directors, etc. and express his/her opinions at the request of the President.

Article14 A secretariat shall be established to handle the affairs of the Society.
2. The Secretariat shall have a Secretary General and some staff members.
3. Secretariat staff shall be appointed and dismissed by the President.
4. Employees shall be paid.

ChapterIV Conference

Article15 The meetings of the Society shall be the General Assembly, the Board of Directors, the Standing Committee, the Executive Committee, and the Committee.

Article16 The General Assembly shall consist of Regular Members and Special Members and shall be divided into Regular General Assembly and Extraordinary General Assembly.
2. The ordinary general meeting shall be convened within two months after the end of each fiscal year.
3. An extraordinary general meeting shall be convened when it is not possible to wait for the annual general meeting due to the following reasons:
    (1) When deemed necessary by the Board of Directors
    (2) When 100 or more regular members and special members request the holding of a general meeting, indicating the matters to be discussed.

Article17 A general meeting shall be convened by notifying the members at least two weeks in advance, indicating the agenda, date, time, and place.
2. The Chairperson of the General Assembly shall be the President.

Article18 The General Assembly shall resolve the following:
    (1) Business plan and budget, and business report and calculation of income and expenditure
    (2) Establishment, revision and abolition of management policies and regulations
    (3) Management and disposal of property
    (4) Election of Vice President, Directors and Auditors
    (5) Other important matters necessary to achieve the objectives of the Society

Article19 The General Assembly shall not be able to hold proceedings and adopt resolutions unless at least 100 members are present. However, members who are unable to attend the General Assembly may exercise their right of representation by delegating it in writing to the members present. In this case, the member shall be deemed to be present.

Article20 The directors of the Assembly shall be decided by most of the members present, and in the case of a majority of votes, the chairman shall decide.

Article21 The Board of Directors shall be convened by the President and shall deliberate important matters concerning the execution of the business of the Association.
2. A meeting of the Board of Directors may not be deliberated unless one-half or more of the members are present, including proxies.

Article22 The Director residing in the Sendai area shall become a Standing Director and constitute the Standing Board of Directors.

2 The President chairs the Standing Committee, which organizes the agenda for the General Assembly and Board of Directors meetings.

Article23 From among the Standing Directors, the President shall appoint up to three Standing Directors each to oversee general affairs, accounting, and editing.

2. The Chairperson, Vice Chairpersons and Executive Directors of the Sendai District shall constitute a Standing Committee to discuss daily business.

Article24 Committees may be established to assist the executive directors in their work.

2. Committee members shall be appointed by the President upon recommendation of the Executive Director.

Chapter V Accounting

Article25 Accounting shall be determined separately.

Article26 The expenses of the Society shall be funded by the following income:

(1) Membership fee

(2) Donations

(3) Other income

Article27 The following shall be the basic assets of the Society, and their management shall be subject to the resolution of the General Assembly.

(1) Those incorporated by resolution of the General Assembly

Article28 The fiscal year of the Society shall begin on April 1 of each year and end on March 31 of the following year.

Chapter VI Account book

Article29 The following books shall be kept in the Society and may be inspected by the members.

(1) Account book

(2) Minutes

(3) Membership list

Chapter VII-Change of constitution

Article30 Changes to this constitution must be agreed to by at least one-third of the members present at a general meeting.

Chapter VIII-Dissolution

Article31 In order to pass a resolution to dissolve the Society, the consent of four-fifths or more of the members present must be obtained at a general meeting.

Article32 The disposition of residual assets in the event of dissolution of the Society shall be determined by resolution of the General Assembly.

Supplementary Provisions

This Constitution shall come into effect on December 1, 1956.

This Constitution shall come into effect as of April 1, 1963.

This Constitution shall come into effect on June 1, 1971.

This Constitution shall come into effect on June 1, 1974.

This Constitution shall come into effect on May 20, 1977.

This Constitution shall come into effect on April 1, 1978.

This Constitution shall come into effect as of April 1, 1986.

This Constitution shall come into effect on May 22, 1942.

Aoba Kogyo-kai (Tohoku University Engineering Alumni Association)

Membership Fee Rules for Regular Members and Student Members

Article1 This constitution shall be established in accordance with Article 25 of the Aoba Kogyo-kai.

Article2 Regular members shall pay 3,000 yen as April membership fee every year and may pay two or more years' membership fee in advance.

Article3 Regular members may pay membership dues for life.

The lifetime membership fee shall be 150,000 yen - [3,000-yen x the number of years regular member membership fees have been paid].

Article4 Academic members shall pay the following student membership fee when they enter the university.

Classification	**Amount of membership fee to be paid**	**Breakdown of membership fees paid**
School of Engineering Student	18,000yen	Student member dues of 12,000 yen for four years and 6,000 yen for the following two years. Total: 18,000 yen
Students transferring to the 3rd years, School of Engineering	12,000yen	Student membership dues for two years and 6,000 yen for the following two years. Total:12,000yen
Students who have not graduated from the School of Engineering and are enrolled in the first two years of the Graduate School of Engineering	6,000yen	6,000 yen for two years of student membership dues. Total:6,000yen

Article5 Student member dues paid by student members who qualify as regular members shall be added to the number of years of regular member dues payment based on the calculation of [student member dues paid/3,000 yen].

Article6 The membership fee paid will not be refunded.

(Effective as of April 1, 2008)

General Assembly of Aoba Kogyo-kai

(Tohoku University Engineering Alumni Association) Regional Branch

Article1 These General Rules are established in accordance with Article 5 of the Aoba Kogyo-kai.

Article2 The Society shall have the following District Chapters:

Hokkaido District Chapters
Tohoku District Regional Chapters (Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima)
Kanto District Chapters (Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi)
Hokuriku District Chapters (Niigata, Toyama, Ishikawa, Fukui)
Chubu District Chapters (Nagano, Gifu, Shizuoka, Aichi)
Kinki District Chapters (Mie, Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama)
Chugoku and Shikoku District Chapters (Tottori, Shimane, Okayama, Hiroshima, Tokushima, Kagawa, Ehime, Kochi)
Kyushu District Chapters (Yamaguchi, Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, Okinawa)

2. Each District Chapter may also have prefectural or sub-regional Chapters, etc., as subordinate organizations.

Article3 Each district chapter shall have one district chapter president and a few secretaries. Other necessary officers may be appointed.

Article4 The head of a district chapter shall also serve as a director of the Society, represent the district chapter, and supervise the affairs of the chapter.

Article5 Important matters related to the operation of the district chapter shall be decided at the general meeting of the district chapter.

Article6 The district branch chief shall periodically report the business plan, business report, budget, settlement of accounts, and changes in officers to the President.

Article7 Chapters and Sub-regional Chapters shall be subsidized by the Society for the time being.

About subsidies:

1. In either case, please pay the membership fee in a lump sum from the Chapters or Sub-regional Chapters
   To the Sub-regional Chapters 150 yen (per person)
   To the Chapters 200 yen (per person)
2. In case of individual delivery to the head office
   To the Chapters 100 yen (per person)
3. In the case of prepayment of membership fee or lifetime membership fee payment
   Contact the appropriate Chapters or Sub-regional Chapters
   The amount of 1 or 2 in the preceding paragraph x the number of payment / 3,000 yen.

(Effective as of April 1, 2008)