Outline of the Graduate School of Science and Engineering (Master's Course)

1. Purpose

The Graduate School of Science and Engineering aims to nurture highly specialized professionals who enable innovation that transcends the boundary between science and engineering fields by acquiring not only basic abilities in a wide range of studies and advanced specialized knowledge, but also good ethics and creativity to develop something new.

2. Requirements for Completion

A master's degree will be awarded to students who have been enrolled in the Graduate School of Science and Engineering of the University for 2 years or more, have acquired 30 or more credits from the designated courses of each program, and have passed the dissertation review.

However, with regard to the period of enrollment, if a student has achieved excellent research results, a master’s degree will be awarded to the student on condition that he/she is enrolled in the Graduate School of Science and Engineering for at least 1 year.

The degrees awarded in each program are as follows:

(Degree to be awarded)

Mathematics and Informatics Program	Master of Mathematics and Informatics
Physics and Applied Physics Program	Master of Science and Engineering
Life Science and Material Chemistry Program	Master of Science and Engineering
Earth, Life, Environmental Science Program	Master of Science
Mechatronics Program	Master of Engineering
Materials Science and Engineering Program	Master of Engineering
Civil Design and Engineering Program	Master of Engineering
Advance Clean Energy Program	Master of Science and Engineering

3. Long-term Study System

Long-term study system is for student who has a full-time occupation and difficulty completing his/her Master’s Course within the standard study period because of restricted time for class attendance or conducting research. The

student may extend the study period of up to 4 years.
If application is approved at the time of admission, the student will pay the total amount of the tuition fee of 2 years evenly divided for each semester in the period approved.

The details of the Long-term study system, including the application method, will be informed when we send the documents for the admission procedure by mail.
Note that applications may not be approved.

4. Fields of Education, Teaching Staff in Charge and Research Overview

(Note) 1. ○ indicates a faculty member who can be your advisor.
2. Faculty members marked with an asterisk (*1) are scheduled to retire in March 2027. Faculty members marked with an asterisk (*2) are scheduled to retire in March 2028.

(1) Mathematics and Informatics

Field of Education	Academic Advisor	Research Overview
Mathematical Analysis	Prof. Masato Kikuchi○ Prof. Takashi Koda○ Prof. Keiko Fujita○ Associate Prof. Tatsuya Kawabe○ Associate Prof. Iwao Kimura○ Assistant Prof. Yuki Shimizu Assistant Prof. Naoki Genra○	Number theory, Differential geometry, Topology, Complex analysis, Real analysis, Representation Theory ,and so on.
Mathematical Science of Information	Prof. Kei-ichi Ueda○ Prof. Hiroyuki Yamane○*2 Specially Appointed Prof. Katsuhiko Sato○ Associate Prof. Masakazu Akiyama ○ Associate Prof. Hideo Deguchi○ Assistant Prof. Ken Furukawa	Algebra, Theory of functional equations, Applied analysis, Numerical analysis, Probability theory, and so on.
Computer Software System	Prof. Shigeki Hirobayashi○ Associate Prof. Tadanobu Misawa○ Assistant Prof. Masaya Hasegawa	We conduct education and research on digital signal processing and its applications. Signals of interest include audio, imaging, economics, finance, cosmic rays, biological signal, and, many others. The processing of such signals includes denoising, compression, visualization techniques, and brain-computer interfaces.

Computational Biophotonics	Prof. Takashi Katagiri○ Assistant Prof. Takuya Koyama	We conduct research and education aimed at creating basic principles of next-generation medical measurement and diagnostic technology and building an academic system by combining photon science, laser spectroscopy, optical communication technology and information science.
Medical Information Sensing	Prof. Hideyuki Hasegawa○ Associate Prof. Ryo Nagaoka○ Assistant Prof. Zihang Zhang	We conduct education and research on the theory and applications of noninvasive ultrasonic imaging and sensing of morphological and functional information of biological bodies. In particular, we develop advanced signal- and image-processing techniques, such as ultrasonic beamforming, target motion estimation, and tissue viscoelasticity estimation, for ultrasonic measurements.
Biological Information Processing	Prof. Toshihide Tabata○ Associate Prof. Mamoru Takamatsu○	We conduct education and research in bioinformatics. We investigate the relationship between gene sequence, protein structure/function, eural/cardiac function, behavior, and disease using computer protein structure modeling, in-silico pathogenicity prediction, and electrophysiological/behavioral measurements. We also conduct education and research on visual information processing engineering, color engineering, evaluation and analysis of CG/3-D visible images, optical and visual environment engineering, traffic visual environment engineering, urban landscape lighting, and the development of universal designs for elderly persons and people with synesthesia.

Cosmic Science Informatics	Prof. Toshihiro Kawaguchi○ Junior Associate Prof. Takuma Watanabe Assistant Prof. Takashi Horiuchi○	We conduct research and education on data science and related modeling for astrophysics and astronomy (e.g., black holes and galaxies). Analyses for multi-dimensional data and time series data, as well as modeling in mathematical sciences are included.
Artificial Intelligence	Prof. Shangce Gao○ Associate Prof. Masaaki Omura○ Assistant Prof. Zhenyu Lei	We conduct education and research on the design, analysis, and evaluation of various artificial intelligent methodologies, including the artificial neural networks which are inspired by the human brain's architecture and information processing mechanisms, the deep learning which is able to learn by itself, particle swarm optimization, ant colony optimization, error back-propagation method, genetic algorithm, evolutionary strategy, and other machine learning technologies.
Quantum Information	Prof. Kiyoshi Tamaki○ Associate Prof. Akihiro Mizutani○	We are working in the field of quantum information, where the application of quantum mechanics offers revolutionary improvements to information processing. In particular, we are aiming at the realization of quantum communication, such as quantum key distribution and quantum repeaters.
Human Informatics	Prof. Takayuki Nozawa○ Associate Prof. Shigeki Ikeda○	We conduct education and research on the analysis and evaluation of human cognition and social interaction, and on the design of information technologies that support people's intellectual activities in real life. For this purpose, we use a combination of multimodal measurement of brain, psychological, physiological, and behavioral activities with data science and artificial intelligence techniques.

Quantum Control Theory	Specially Appointed Prof. Koji Maruyama○	Our principal interests are in the theory of quantum control, which will support the future technologies based on quantum mechanical effects. We study mathematical foundations of quantum many-body dynamics from the control perspective.
Computer Vsion	Specially Appointed Prof. Chao Zhang○	If machines can recognize, track, and inspect in place of the human eye, these “mechanical eyes,” which never need to rest, can tirelessly perform their tasks. We conduct research and education to realize the human function of “seeing” through machines (cameras).
Clinical Photonics and information Engineering	Specially Appointed Prof. Yusuke Oshima○	Optical devices and spectroscopic analyses with mathematical approaches for clinical practice, e.g. in minimally invasive surgery, intraoperative cancer diagnosis.

(2) Physics and Applied Physics

Field of Education	Academic Advisor	Research Overview
Solid State Physics	Prof. Tomohiko Kuwai○ Associate Prof. Takashi Tayama○ Assistant Prof. Yuji Matsumoto○	Magnetic, electrical and thermal properties of condensed matter including strongly correlated electron systems at low temperatures.
Nanophysics	Prof. Hiroyuki Ikemoto○*1 Associate Prof. Keisuke Hatada○	Structures and properties of nanoparticles and disordered systems.
Theoretical Physics	Associate Prof. Mitsuru Kakizaki○	Theoretical elementary particle physics, cosmology and related topics.
Experimental Astroparticle Physics	Assistant Prof. Yuuki Nakano○	Neutrino astronomy, Cosmic-ray muon, Dark matter, Radioactive assay
Microwave Physics	Prof. Kaori Kobayashi○ Associate Prof. Katsunari Enomoto○	Microwave and laser spectroscopy of molecules; Control of molecular motion.

Laser Physics	Prof. Yoshiki Moriwaki○ Associate Prof. Kazuhiro Yamamoto○ Assistant Prof. Mai Takeo	Development of coherent light sources and their application to precise optical measurements, spectroscopic works and gravitational wave detection.
Nanoelectronics Engineering	Prof. Masayuki Mori○	We study fabrication processes, epitaxial growth, and characterization technologies for semiconductor devices in order to realize next-generation high-performance integrated circuits.
Structural Physics and Materials Science	Associate Prof. Toshio Kikuta○	Research activities focus on structural phase transitions, ordering phenomena, and domain structures in functional materials, particularly ferroelectrics, through examination of the relationships between crystal structures and physical properties. The research aims to elucidate the mechanisms underlying emergent physical properties and their potential applications.
Organic Optical Device Engineering	Prof. Shigeki Naka○	We conduct education and research on optical and electrical properties, structure control, electro-optical conversion, optical-electrical conversion of organic electronic materials, and their applications based on optical control, e.g. organic light-emitting devices, organic photodiodes, organic photovoltaic cells, and other organic optical devices.
Microstructure Control Engineering	Prof. Kenji Matsuda○ Associate Prof. Seungwon Lee Assistant Prof. Taiki Tsuchiya	The microstructure control engineering course is focused on establishing and designing new metallic materials for energy saving and environmental conservation. Research topics also include advanced microstructure control technologies using high-resolution transmission electron microscopy and scanning electron microscopy.

Solid State Engineering	Associate Prof. Takahiro Namiki○	We conduct education and research on the electric, magnetic, and thermal properties of superconductors, magnetic materials, and cryogenic materials of alloys, intermetallic compounds, and conductive oxides to achieve improved performance and applications of the materials.
Metallurgical Engineering of Iron and Steel Materials	Prof. Hideki Ono○ Junior Associate Prof. Kengo Kato	Targets of education and research are elemental technologies of the production of high performance iron and steel materials. The main subjects are 1) energy saving and reduction of environmental loads in iron- and steel-making processes, 2) development of high purity refining method, 3) control of inclusions in steel, and 4) Recycling of ferrous scraps.
Computational Materials Engineering	Prof. Norio Nunomura○	In order to understand and apply the diversity and complexity of the microscopic structure of materials, we conduct education and research on material design, structural analysis and functional prediction from atomic scale using computer simulation.
Plasma Physics	Prof. Yasuhiro Nariyuki○	Nonlinear and nonequilibrium phenomena in plasmas, and application of mathematical modeling
Atomic and molecular physics	Prof. Yasumasa Hikosaka○ Associate Prof. Hayato Ohashi○	We deepen the understanding of fundamental atomic and molecular processes induced by collisions with short-wavelength light and highly-charged ions, and conduct education on the physics of few-quantum many-body systems.

Fluid Geophysics	Prof. Kazuma Aoki Associate Prof. Wataru Shimada	Research on the phenomena of changes in the atmosphere, oceans, land, and cryosphere that constitute the Earth's climate system and their interactions, and environmental science research on the physical properties of snow, ice, and clathrate hydrates and atmospheric particulate matter by physical methods
Radio System	Associate Prof. Kazuhiro Honda○	Education and research will be conducted on advanced use of computers, development of new frequency resources, and communication systems, including electromagnetic field analysis, signal processing, communication and network-related technologies, and devices and measurement systems.

(3) Life Science and Material Chemistry

Field of Education	Academic Advisor	Research Overview
Nanomaterials Chemistry	Junior Associate Prof. Hiroyasu Nishi○	We study preparation, physical and chemical properties, and photofunctions of metal and compound semiconductor nanomaterials. We also focus on novel nanofabrication techniques based on electrochemical and photoelectrochemical methods
Physical Chemistry	Associate Prof. Honoh Suzuki○*1 Junior Associate Prof. Munetaka Iwamura○ Assistant Prof. Tsukasa Takanashi	Photophysics and photochemistry of luminescent organic compounds or transition-metal complexes using ultrafast laser spectroscopy. Solution chemistry and thermodynamics for potential applications in medicine and optical devices.

Coordination Chemistry	Prof. Kiyoshi Tsuge○ Associate Prof. Hideki Ohtsu○	Coordination compounds, being composed of metal ions and organic/inorganic ligands, have huge diversity and potential. In this laboratory, coordination compounds with novel structures and properties are being prepared. Our interests are divided into three areas: 1. emissive coordination complexes; 2. multinuclear complexes that respond to external stimuli; and 3. functional complexes, inspired by renewable energy conversion in nature, which exhibit catalytic activity toward the reduction of CO_2, O_2, and N_2.
Organic Chemistry	Prof. Naoto Hayashi○ Assistant Prof. Junro Yoshino○	We synthesize numerous compounds with new, hitherto unknown properties, and then investigate the intricacies of their structures. Some of the compounds we have created include fragrant compounds and emerald crystals. The nature of such compounds and their molecular structure are intimately related. Currently, we are developing compounds that are highly responsive to heat, light, and magnetic fields.
Natural Products Chemistry	Junior Associate Prof. Hajime Yokoyama	Numerous bioactive organic compounds occur in nature, many of which possess complex structures with large numbers of asymmetrical carbon atoms. We are developing useful reactions for the synthesis of such complex-structured organic compounds, and applying these compounds to the synthesis of bioactive natural products.

Biofunctional Chemistry	Prof. Yoshiya Ikawa○ Junior Associate Prof. Shigeyoshi Matsumura	RNAs play versatile roles in biological systems because they not only serve as a genetic material but also act as functional molecules. We study the molecular basis of naturally occurring RNAs with catalytic and receptor functions. Another interest of our group lies in the artificial generation of RNAs with desirable functions through rational and evolutional approaches.
Organic Electrosynthesis	Assistant Prof. Kazuhiro Okamoto	Our focus is on developing new synthetic reactions for nitrogen-containing compounds using an electrochemical approach.
Engineering based on Genetic Information	Prof. Nobuyuki Kurosawa○ Prof. Tatsuhiko Ozawa Junior Associate Prof. Sei-ichi Koike Assistant Prof. Maki Moriwaki	Our work includes a systematic analysis of immune molecules, such as antibodies, as well as studies on the regulation of intracellular organelles. Additionally, we explore material production through biological reaction engineering.
Pharmacology	Associate Prof. Ichiro Takasaki○	Our aim is to provide researchers and engineers with the knowledge and technology of pharmacology and genetic engineering. Our research group aims to elucidate the mechanisms of chronic pain and neuropsychiatric disorders and develop new medications against them.
Electrical Engineering on Cells	Junior Associate Prof. Minoru Suga	Research and education in the combined fields of cell engineering and electrical engineering. Development of cell manipulation techniques by applying electric fields and their application to cell analysis and cell separation.

Brain and Neural Systems Engineering	Prof. Shigenori Kawahara○*1	By using relatively simple invertebrate neural networks, we conduct education and research on phase-dependent processing of sensory information in synchronous neural activities and dynamic interaction among the nonlinear oscillators in the brain as well as between the brain and rhythmic sensory inputs.
Biomaterials Process Engineering	Assistant Prof. Shintaro Iwanaga	We conduct education and research on biofabrication of tissue/organ by biomedical engineering and regenerative medicine engineering through the synthesis and processing of biomaterials with a background in biomaterials engineering.
Bio-functional Molecule Engineering	Associate Prof. Takuya Okada○	The principal focus of this group is the development of the design and synthesis procedure of small molecules, as well as their biological evaluation as candidates in drug discovery.
Process Systems Engineering	Associate Prof. Taketoshi Kurooka○	We conduct education and research on process systems engineering, which addresses the optimal design, operation, and control of complex systems, such as chemical, biochemical, petrochemical, and pharmaceutical processes.
Protein System Engineering	Associate Prof. Tomonao Inobe○	Proteins are necessary for virtually every activity in the human body. Our goal is to understand how proteins are produced and degraded in the cell in terms of protein science and biophysics. Based on the above knowledge, we also aim to develop novel technologies that can regulate the lifespans of proteins for various practical applications.

Catalysis, Energy and Material Engineering	Prof. Noritatsu Tsubaki○ Associate Prof. Guohui Yang○ Specially Appointed Associate Prof. Shuhei Yasuda○ Specially Appointed Junior Associate Prof. He YingluO	We research the development of environmentally friendly catalysis processes, the green utilization of natural resources including biomass and sunlight, the development of alternative energy instead of petroleum, and novel nanomaterials.
Environmental and Functional Molecular Chemistry	Prof. Shigehiro Kagaya○ Associate Prof. Makoto Gemmei○	Education and research are conducted on the following: 1) synthesis of materials containing functional molecules and polymers, 2) establishment of techniques using these materials for separation and preconcentration of elements, and 3) application of the techniques to environmental analysis, treatment of wastewater, and recovery of rare elements. Research on the adsorption and desorption behaviors of materials at the solid-liquid interface, including the development of surface modification techniques and antifouling materials, is also conducted.
Applied Inorganic Chemistry	Associate Prof. Akira Miyazaki○	We conduct educational and research activities focused on the design and synthesis of molecular systems based on organic compounds, transition metal complexes, organometallic compounds, and metal nanoparticles that exhibit novel properties, such as electrical conductivity and magnetism. These activities also encompass the systematic measurement and analysis of their physical properties.

Computers and Applied Chemistry	Prof. Tatsuya Ishiyama○	The recent rapid development of computer technology has enabled us to analyze and predict various chemical reactions and molecular dynamics based on computational chemistry. This class summarizes the basic theory of ab initio electronic structure calculations, such as molecular orbital and density functional methods.
Biomolecular Chemistry	Associate Prof. Masafumi Sakono○	Organic chemistry has been vigorously applied to molecular biology. Our objectives are to reveal the properties of biomolecules using various methods based on chemical biology. We also engage in the development of new techniques for the analysis of intermolecular interactions, such as protein-protein interactions.
Synthetic and Medicinal Chemistry	Prof. Hitoshi Abe○ *2	This field focuses on creation of novel “functional organic molecules” based on the advanced synthetic organic chemistry. The newly designed organic molecules possess some potential to contribute to various fields of science such as discovery of novel medicines and agrichemicals. Research in our group is primarily aimed toward the development of catalytic reactions and methods for organic synthesis for the functional organic molecules.

Environmental Analytical Chemistry	Assistant Prof. Akira Kanno	We conduct educational research on the design and synthesis of highly functional optical sensor molecules for the sensing of metabolites, such as glucose or lactate, and ions, such as potassium or sodium, in the human body, and the application of such molecules in a novel optical sensing system for the minimally invasive monitoring of vital ions and metabolites as a tool for biochemical and clinical analyses.
Enviromental Chemical Engineering	Assistant Prof. Guiqing Liu	With comprehending operation principles of pyrolysis, combustion, adsorption/ absorption, and fluidized beds, we conduct education and research focusing on energy saving and environmental pollution control technologies. Especially, we make effort on the development of novel adsorbents for CO2 capture, and new technologies for acidic gas emission control and fluidized bed granulation.
Biomaterial Designing and Engineering	Associate Prof. Tadashi Nakaji○	In our research field, the design of biomaterials and the construction of concept for the regenerative medicine are conducted in based on protein engineering, polymer science, cell biology, and molecular biology. Especially, we aim to construct functional biomaterials such as screening devices for various diseases and supporting materials for cell transplantation to cure otherwise intractable disorders.
Environmental Chemical Measurement	Prof. Hideki Kuramitz	Development of analytical methods for trace constituents in water and removal methods for toxic constituents in wastewater, research on origin, circulation, and distribution of substances using trace elements and isotopes, etc.

Hydrogen Isotope Science	Prof. Takayuki Abe*1 Prof. Masanori Hara Associate Prof. Hidehisa Hagiwara○ Junior Associate Prof. Akira Taguchi Assistant Prof. Satoshi Akamaru	Research on hydrogen isotope functionality and functional materials as fuels for hydrogen energy and fusion reactors Research on isotope effects of hydrogen and tritium decomposition effects

(4) Earth, Life, Environmental Science

Field of Education	Academic Advisor	Research Overview
Structural Biology	Associate Prof. Yuji Yamazaki○ Associate Prof. Kiyoto Maekawa○ Associate Prof. Tsutomu Tsuchida○ Assistant Prof. Kyoko Sato○ Assistant Prof. Gohta Kinoshita○	Morphology, phylogenetic systematics, and population dynamics of insects, fishes, birds, and mammals. Community structures and dynamics of insects and their symbiotic microorganisms. Cytotaxonomy of flowering plants.
Cell Biology	Prof. Ichirou Karahara○ Specially Appointed Associate Prof. Tomoaki Nishiyama○ Junior Associate Prof. Masayuki Yamamoto Junior Associate Prof. Daisuke Tamaoki○	Genome structure and functions; Environmental effects on development of plant organ, tissue, and cells; plant molecular genetics.
Regulatory Biology	Prof. Kouhei Matsuda○*2 Prof. Masayuki Ikeda○ Prof. Kimiko Shimizu○ Prof. Tomoko Yoshikawa○ Junior Associate Prof. Norifumi Konno○ Junior Associate Prof. Tomoya Nakamachi○ Junior Associate Prof. Eri Morioka	Physiology and biochemistry of functional peptides and their receptor signaling in fishes, amphibians, and mammals; sleep regulations, circadian rhythms and photoperiodism in insects and mammals; genetic manipulation and behavioral analysis.
Environmental and Analytical Chemistry	Prof. Jing Zhang○ Prof. Hideki Kuramitz○ Prof. Keiji Horikawa○ Junior Associate Prof. Kazuto Sazawa○ Junior Associate Prof. Takanori Kagoshima○	Environmental/analytical chemistry; geochemical engineering; geochemistry; paleoceanography; marine chemistry; bio/chemical sensor
Environmental Biology	Prof. Daisuke Tanaka○ Prof. Naoya Wada○ Prof. Hiroshi Ishii○ Associate Prof. Hiroyuki Kamachi○ Associate Prof. Kenji Kashiwagi○ Junior Associate Prof. Akihiro Sakatoku○ Junior Associate Prof. Tamihisa Ota○ Assistant Prof. Peterson Miles Isao	Environmental biology; ecology; plant-animal interactions; microbiology; plant physiology; conservation biology

Solid Earth Geophysics	Prof. Tohru Watanabe○ Prof. Naoto Ishikawa○*1 Associate Prof. Kazuo Kawasaki○ Junior Associate Prof. Kohei Hotta○	Physics of Earth's interior; Seismology; Geodesy; Paleomagnetism; Environmental magnetism
Geophysical Fluid Dynamics	Prof. Kazuaki Yasunaga○ Prof. Kazuma Aoki○ Prof. Konosuke Sugiura○ Prof. Bunmei Taguchi○ Prof. Masahiro Hori○ Associate Prof. Wataru Shimada○ Associate Prof. Atsushi Hamada○	Meteorology; climate dynamics; atmospheric physics; ocean dynamics; glaciology; interaction of atmosphere, hydrosphere and lithosphere; cryosphere science; solid-state physics and environmental science of ice and snow; nucleation and growth of clathrate hydrates.
Geological Science	Prof. Yasuo Ishizaki○ Prof. Shin-ichi Sano○ Associate Prof. Ken-ichi Yasue○ Associate Prof. Ryo Tateishi Junior Associate Prof. Ai Kawamura○ Assistant Prof. Hikaru Sawada○ Assistant Prof. Toru Nakajima○	Earth system history; engineering geology; geoinformatics; hazard geology; mineral sciences; paleontology; petrology; resource geology; sedimentary geology; seismogeology; tectonics and geochronology; volcanology.

(5) Mechatronics

Field of Education	Academic Advisor	Research Overview
Pulsed Power and Plasma Engineering	Prof. Hiroaki Ito○ Assistant Prof. Taichi Takezaki	We conduct education and research on advanced high voltage and plasma engineering, such as the development of pulsed power technology and its application to intense pulsed particle beam, high-density pinched plasma, atmospheric pressure plasma, high-power microwave, and laboratory astrophysics.

Power Electronics	Associate Prof. Kenji Amei○	We conduct education and research on the development of power conversion circuits and control methods that enable high-efficiency power conversion and the generation of desired voltage and current waveforms.
Applied Electromagnetic Systems	Prof. Takahisa Ohji○	Education and research activities involve electromagnetic devices based on the mutual conversion of electrical, magnetic, and mechanical energy—specifically applied electromagnetic systems represented by magnetic suspension technology.
Electromagnetic actuator	Associate Prof. Masayuki Kato○	We conduct education and research related to electromagnetic motors and actuators, linear drive technology, and electromagnetic field analysis.
Dynamical Systems and Robotics	Prof. Kenji Hirata○	Our education and research activities focus on dynamical systems, control and robotics. The topics include decentralized control, hybrid systems and networked control as well as autonomous mobile robots, bio-inspired robots, rehabilitation robots.

Autonomous Systems	Associate Prof. Junya Yamauchi○	Based on control engineering and robotics, we conduct education and research on robot path planning, autonomous control, and human-robot collaborative systems from the perspective of cyber-physical systems.
Biomimetic Robotics and Control Engineering	Associate Prof. Hideki Toda○	We conduct education and research in the control theory and applications of systems inherent in biomimetic robotics, including autonomous mobile robots (such as aerial vehicles), bio-robots, rehabilitation robots, and technologies that mimic biological functions, such as SLAM and image processing.
System Control	Prof. Kazuki Nakajima○*2	We conduct education and research in a wide range of bio-information systems, such as the methods of analyzing and measuring biological information and the development of health-care devices, considering both hardware and software, which are based on measurement, control, information processing, and system engineering.
Imaging Science	Associate Prof. Tatsuo Nozokido○*1	To visually represent complex or inherently invisible phenomena in an easily understandable way through imaging, we conduct research and provide education on imaging technologies that utilize millimeter-wave and terahertz electromagnetic waves.

Radio System	Associate Prof. Kazuhiro Honda○	Education and research will be conducted on advanced use of computers, development of new frequency resources, and communication systems, including electromagnetic field analysis, signal processing, communication and network-related technologies, and devices and measurement systems.
Wave Communication Engineering	Associate Prof. Masafumi Fujii○	Education and research are conducted in basic and applied fields of electromagnetic (EM) wave including metamaterials, interaction between human body and EM wave, radio wave anomaly associated with earthquakes, as well as their massively-parallel super-computation from nano to earth-scale ranges.
Applications of Optical Sensing	Prof. Seiichiro Ariyoshi○	We conduct education and research on the advanced utilization of computers and the development of new frequency resources and communication systems, such as electromagnetic field analysis, signal processing, network connection techniques, and millimeter-wave and terahertz engineering.
Strong Order and Devices	Prof. Hiroshi Naganuma○	We aim to develop devices such as memory and sensors by combining strong order with the quantum tunneling effect. Furthermore, we conduct education and research on the integration of these technologies with state-of-the-art semiconductor devices.

Nanoelectronics Engineering	Prof. Masayuki Mori○	We study fabrication processes, epitaxial growth, and characterization technologies for semiconductor devices in order to realize next-generation high-performance integrated circuits.
Structural Physics and Materials Science	Associate Prof. Toshio Kikuta○	Research activities focus on structural phase transitions, ordering phenomena, and domain structures in functional materials, particularly ferroelectrics, through examination of the relationships between crystal structures and physical properties. The research aims to elucidate the mechanisms underlying emergent physical properties and their potential applications.
Organic Optical Device Engineering	Prof. Shigeki Naka○	We conduct education and research on optical and electrical properties, structure control, electro-optical conversion, optical-electrical conversion of organic electronic materials, and their applications based on optical control, e.g. organic light-emitting devices, organic photodiodes, organic photovoltaic cells, and other organic optical devices.
Organic Thin Film Electronics	Prof. Masahiro Morimoto○	We fabricate and manipulate organic thin films, and evaluate the thin film electronic properties. In addition, education and research are conducted on device applications and electronics based on these electronic functionalities.

Solid Mechanics	Prof. Katsuyuki Kida○ Associate Prof. Koshiro Mizobe○ Assistant Prof. Soji Matsubayashi	We focus on mechanical structures under complex physical conditions. Their behaviors are linked to stresses, displacements, and fracture thresholds of the structures. We conduct education and research based on the quantitative evaluation of the fracture process and the investigation of fracture mechanisms using experimental methods, observations, and numerical analysis.
Reliability Engineering	Prof. Noriyasu Oguma○*2 Associate Prof. Kenichi Masuda○	Based on theory that combines micro- and macro-scale approaches to strength and fracture mechanism of machinery, education and research on structural design, fatigue design, and safe/reliability evaluation methods are conducted for structural materials, functional materials and medical materials.
Advanced Materials and Forming	Prof. Tomomi Shiratori○ Junior Associate Prof. Noboru Takano Assistant Prof. Tatsuya Funaduka	We conduct education and research on the optimal design and applications of machining tools, based on improving the required plasticity characteristics and working processes of various structural and functional materials, involving the control of materials compositions and the analysis of plastic deformation.
Thermal Engineering	Associate Prof. Koichi Kasaba○ Assistant Prof. Akio Kosaka	For strength evaluation of structural components for cryogenic temperature and electrical and mechanical properties evaluation of superconducting materials, we conduct education and research on the basics and applications of Material mechanics, Fracture mechanics, Heat transfer engineering and Superconducting engineering.

Fluid Mechanics	Prof. Sei-ichiro Izawa○ Junior Associate Prof. Atsushi Kase Assistant Prof. Mami Iwasaki	In addition to basic issues such as flow instability, turbulence, and flow around objects, education and research will be conducted on applied issues such as insect flight, in vivo flow, and effective use of natural energy.
Intelligent Machine	Prof. Yoshiyuki Matsumura○ Junior Associate Prof. Masahiro Sekimoto	For the development of advanced mechatronics intended to create high-precision, high-speed, high-response machinery, we conduct education and research on dynamical analysis and the configuration and design of new mechanical systems.
Control System	Prof. Toshiyuki Yasuda○ Junior Associate Prof. Tomaru Takenori	We conduct education and research on development of control systems such as human cooperation robot systems considering human emotion, visual servo systems based on image processing technology, and swarm systems using evolution and learning approaches.
Mechanical Information and Instrumentation	Prof. Tohru Sasaki○ Associate Prof. Kenji Terabayashi○	Our aim is image-position measuring of large-scale environments and force sensing for micro-handling. We conduct education and research on the development of new measuring methods, systems, and sensors. We also focus on robotic vision systems including 3D measurement and object recognition based on image processing.

Applied Mechano-Informatics	Prof. Takeshi Seta○ Junior Associate Prof. TATIANA Zolotoukhina Junior Associate Prof. Daisuke Watanabe	We conduct education and research on numerical analysis and simulation technology utilizing computers, to clarify and control various physical phenomena/property in mechanical engineering problems such as atomic and molecular motion, a multiphase flow, and a turbulent flow.

(6) Materials Science and Engineering

Field of Education	Academic Advisor	Research Overview
Materials Forming and Engineering	Prof. Seiji Saikawa○*1	We conduct education and research related to the processing and design of fabricated materials based on the phase transition from liquid to solid, through the development and application of melting, casting, and solidification techniques of metal and the forming of materials, to produce high-performance and high-function fabricated materials.
Microstructure Control Engineering	Prof. Kenji Matsuda○ Associate Prof. Seungwon Lee○ Assistant Prof. Taiki Tsuchiya	The microstructure control engineering course is focused on establishing and designing new metallic materials for energy saving and environmental conservation. Research topics also include advanced microstructure control technologies using high-resolution transmission electron microscopy and scanning electron microscopy.
Functional Material Design Engineering	Associate Prof. Takashi Hashizume○	Education and synthetic research and development are conducted on the functional materials of ceramics, metals, and new complex materials through designing, structural control, combining additives such as rare earth metals, improving fabrication processes, and evaluating their properties and applications.

Materials Environment and Surface Processing	Associate Prof. Masahiko Hatakeyama○	In order to improve the corrosion resistance of metal materials, we investigate and instruct about electrochemical methods in various alloys. We focus especially on the characterization of passivation films and functional films that are fabricated by electrochemical methods.
Solid State Engineering	Associate Prof. Takahiro Namiki○	We conduct education and research on the electric, magnetic, and thermal properties of superconductors, magnetic materials, and cryogenic materials of alloys, intermetallic compounds, and conductive oxides to achieve improved performance and applications of the materials.
Materials Processing Engineering Laboratory	Associate Prof. Masamichi Yoshida○*1 Assistant Prof. Takeshi Yamane	Targets of education and research in this laboratory are the key fundamental processes for industrial products, starting from the designing of materials addressing the control of phenomena in materials through elucidating their mechanisms, and optimizing their related production processes. The main subjects are 1)heat and mass transfer phenomena, 2)visualization techniques, 3)surfaces and interfaces, and 4)joining and welding.
Metallurgical Engineering of Iron and Steel Materials	Prof. Hideki Ono○ Prof. Satoru Murata Junior Associate Prof. Kengo Kato	Targets of education and research are elemental technologies of the production of high performance iron and steel materials. The main subjects are 1) energy saving and reduction of environmental loads in iron- and steel-making processes, 2) development of high purity refining method, 3) control of inclusions in steel, and 4) Recycling of ferrous scraps.

Computational Materials Engineering	Prof. Norio Nunomura○	In order to understand and apply the diversity and complexity of the microscopic structure of materials, we conduct education and research on material design, structural analysis and functional prediction from atomic scale using computer simulation.
Photofunctional Material	Prof. Yutaka Takaguchi○ Assistant Prof. Katsuhiro Tanaka	Education and research are conducted into the design and synthesis of new photofunctional materials based on surface-modified nanomaterials that enable hybridization with organic or inorganic materials so that they can be used in the development of artificial photosynthesis systems and applications in the field of nanomedicine.
Materials Plasticity Engineering	Prof. Tetsuo Aida○	For various industrial materials, we conduct education and research on molding methods, plastic working deformation behavior and applications of molding materials controlled by advanced processing technology.
Engineering for Reaction Design	Prof. Satoru Murata○	We conduct education and research related to the design of reactions for the highly effective conversion and utilization of petroleum-derived materials from engineering perspective.
Design of Lightweight Structural Materials	Prof. Takuya Ishimoto○ Assistant Prof. Tomoyo Manaka	To create materials that meet the ever-increasing demands of society, education and research are conducted on the design of multifunctional metallic materials that are not only lightweight and strong, but also have multiple functionalities such as corrosion resistance and biological functions, based on the superposition of structure/shape and microstructure control.

(7) Civil Design and Engineering

Field of Education	Academic Advisor	Research Overview

Geotechnical structure design engineering	Prof. Takashi Hara○*1 Associate Prof. Naoki Tatta	Education and research concerning geotechnical structure design engineering, such as static/dynamic interaction between ground and structure, risk management for disaster prevention, sophistication of geotechnical design and disaster prevention practices, and so on, are conducted.
Structural Mechanics and Bridge Engineering	Associate Prof. Yasuo Suzuki○	We conduct education and research on structural mechanics and bridge engineering. In specific, with regard to steel, steel-concrete composite and fiber reinforced polymer bridge structures, the mechanical behavior of connection of members, the load carrying mechanism, the performance evaluation, the rational design and so on are studied.
Infrastructure planning	Prof. Yutaka Honda*1 Associate Prof. Hiroto Inoi○ Associate Prof. Yuriko Takayanagi Junior Associate Prof. Liu Qiang	With the aim of creating safe and comfortable urban spaces, we conduct research and education on the integrated planning and operation of transportation and urban spaces. This includes evaluating the social impacts of securing transportation options for local residents and improving public transportation; verifying methods and outcomes of resident participation in transportation-oriented urban planning; formulating countermeasures based on analyses of the causes of traffic congestion and traffic accidents; and assessing the safety and comfort of transportation hubs and pedestrian spaces.
Environmental Engineering for Architecture and City Planning	Prof. Yuji Hori○ Prof. Yuki Akizuki○	Education and research on "Zero Energy Buildings and Urban Energy Management for the smart city", "Environmental elements of urban architectural space for comfort, health, and safety", "Visual environment design in architecture and landscape"

Design Management	Prof. Yoshiaki Kubota○ Assistant Prof. Wang Yongcheng	・Design excellence of public space and urban infrastructure from the perspectives of functionality and urban landscape ・Institutional capacity and governance (e.g., international comparative studies of public procurement systems) ・Revitalization of and community building in urban areas (e.g., residential living in the urban core, street audit and analysis)
Intelligent Information Processing	Prof. Yuukou Horita○*1	We conduct education and research on a system for estimating human emotions, preferences, and satisfaction using wearable devices, analysis of the relationship between traffic volume on roads around large-scale facilities and external factors, disaster category identification from aerial images, and forest science.
Computational Science	Associate Prof. Takayuki Haruki○	We conduct teaching and research on software systems development for civil design and engineering, the numerical analysis of biological information in pre-disease science, and particle-in-cell simulations.
Systems Engineering	Associate Prof. Tadanobu Misawa	Education and research is conducted on digital signal processing and its applications related to noise suppression, compression, visualization techniques, and brain-computer interfaces for various signals such as acoustic, image, economic, financial, cosmic ray, and biological signals.
Fluid Geophysics	Prof. Kazuaki Yasunaga	Research on the phenomena of changes in the atmosphere, oceans, land, and cryosphere that constitute the Earth's climate system and their interactions, and environmental science research on the physical properties of snow, ice, and clathrate hydrates and atmospheric particulate matter by physical methods

Geodesy	Associate Prof. Ryo Tateishi	Research on rocks and ore deposits in the world's variable zones and the tectonics that regulate them, research on magma and volcanic eruptions, research on sedimentology, stratigraphy and paleontology, research on earth history, research on earthquakes, faults, and natural disasters

(8) Advance Clean Energy

Field of Education	Academic Advisor	Research Overview
Hydrogen Isotope Science	Prof. Takayuki Abe○*1 Prof. Masanori Hara○ Associate Prof. Hidehisa Hagiwara○ Junior Associate Prof. Akira Taguchi○ Assistant Prof. Satoshi Akamaru○	We conduct education and research on the physicochemical properties of hydrogen isotopes and the development of functional materials for safe and efficient utilization of hydrogen isotopes as fuels of fusion reactors and hydrogen energy systems. Our research topics are in an interdisciplinary field that covers materials science, physical chemistry, nuclear fusion engineering, and hydrogen energy engineering.
Physical Chemistry	Associate Prof. Honoh Suzuki○*1 Junior Associate Prof. Munetaka Iwamura○	Photophysics and photochemistry of luminescent organic compounds or transition-metal complexes using ultrafast laser spectroscopy. Solution chemistry and thermodynamics for potential applications in medicine and optical devices.

Coordination Chemistry	Prof. Kiyoshi Tsuge○ Associate Prof. Hideki Ohtsu○	Coordination compounds, being composed of metal ions and organic/inorganic ligands, have huge diversity and potential. In this laboratory, coordination compounds with novel structures and properties are being prepared. Our interests are divided into three areas: 1. emissive coordination complexes; 2. multinuclear complexes that respond to external stimuli; and 3. functional complexes, inspired by renewable energy conversion in nature, which exhibit catalytic activity toward the reduction of CO2, O2, and N2.
Organic Chemistry	Prof. Naoto Hayashi○ Assistant Prof. Junro Yoshino○	We synthesize numerous compounds with new, hitherto unknown properties, and then investigate the intricacies of their structures. Some of the compounds we have created include fragrant compounds and emerald crystals. The nature of such compounds and their molecular structure are intimately related. Currently, we are developing compounds that are highly responsive to heat, light, and magnetic fields.
Catalysis, Energy and Material Engineering	Prof. Noritatsu Tsubaki○	We research the development of environmentally friendly catalysis processes, the green utilization of natural resources including biomass and sunlight, the development of alternative energy instead of petroleum, and novel nanomaterials.
Computers and Applied Chemistry	Prof. Tatsuya Ishiyama○	The recent rapid development of computer technology has enabled us to analyze and predict various chemical reactions and molecular dynamics based on computational chemistry. This class summarizes the basic theory of ab initio electronic structure calculations, such as molecular orbital and density functional methods.

Plasma Physics	Prof. Yasuhiro Nariyuki○	Nonlinear and nonequilibrium phenomena in plasmas, and application of mathematical modeling
Natural Products Chemistry	Junior Associate Prof. Hajime Yokoyama	Research on development of asymmetric reactions, development of new chemical reactions using transition metals, and synthesis of biologically active natural products. In particular, we conduct research on the synthesis of bioactive natural products (drug seeds) related to biological phenomena and the development of environmentally friendly catalytic reactions and synthesis methods (including material and process development) based on theoretical calculations, with a particular focus on drug discovery and chemical biology research and reaction development.
Biofunctional Chemistry	Prof. Yoshiya Ikawa Junior Associate Prof. Shigeyoshi Matsumura	Elucidation of the mechanism by which nucleic acid polymeric RNAs express sophisticated biological functions, and artificial creation of novel RNA functions based on this mechanism
Organic Electrosynthesis	Assistant Prof. Kazuhiro Okamoto	Our focus is on developing new synthetic reactions for nitrogen-containing compounds using an electrochemical approach.