

Guide of Graduate School of Science and Engineering (Doctoral Course)

The Doctoral Program in Science and Engineering of Graduate School of Science and Engineering consists of four programs: Mathematical Informatics and Data Science Program, Life, Material and Energy Sciences Program, Sustainable Global Environmental Studies Program, and Advanced Engineering Program. The overview of each program is as follows.

(Note) Faculty members marked with an asterisk (*1) are scheduled to retire in March 2028.

Faculty members marked with an asterisk (*2) are scheduled to retire in March 2029.

(1) Mathematical Informatics and Data Science Program

In today's rapidly advancing information society, there is a need for further improvement of the environment to cope with an aging society and to enable people in general to live safely and comfortably.

In this program, we aim to train advanced professionals and researchers who can foresee further advancements in the informatized society and equip themselves with a solid foundation in mathematics, information science, and data science. They will gain comprehensive knowledge in mathematical informatics, critical thinking skills, and problem-solving abilities, allowing them to play important roles in the increasingly informatized society of the future.

Educational field	Education and Research	Supervisors	Related lectures
Basic Computer Engineering	We conduct education and research on software development for practical use of computers, analysis and development of algorithms for useful software and advanced signal processing analysis in computer systems.	Prof. Shigeki Hirobayashi Associate Prof. Tadanobu Misawa Junior Associate Prof. Takuma Watanabe	Advanced Signal Processing Advanced Machine Learning Microwave Sensing
Bio-medical Informatics	We conduct education and research on visual information processing engineering, emotional information processing engineering, sensing and imaging technologies, signal and image processing, pattern recognition, color engineering, evaluation and analysis of CG/3-D visible images, optical and visual environment engineering, traffic visual environment engineering, urban landscape lighting, the hot issues of development of universal design for elderly persons and people with synesthesia, visual neurophysiology, neural computing, synaptic plasticity, bioinformatics, evaluation of human cognition and social interaction and development of hardware and software for image information processing inspired by intriguing human sensory information processing mechanisms.	Prof. Hideyuki Hasegawa Prof. Takashi Katagiri Prof. Toshihide Tabata Specially Appointed Prof. Yusuke Oshima Associate Prof. Mamoru Takamatsu Associate Prof. Ryo Nagaoka Associate Prof. Masaaki Omura	Advanced Medical Ultrasonics Advanced Bio-medical Optics Advanced Biological Information Processing Advanced Clinical Informatics Engineering Advanced Kansei Information Processing Advanced Medical Ultrasonic Measurement Advanced Medical Ultrasonics
Human Informatics	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 employ a combination of multimodal measurement of brain, psychological, physiological, and behavioral activities with data science and artificial intelligence techniques.	Prof. Takayuki Nozawa Associate Prof. Shigeki Ikeda	Advanced Cognitive Interaction Brain Information Engineering
Artificial Intelligence	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.	Prof. Shangce Gao Assistant Prof. Zhenyu Lei	Advanced Computational Intelligence Advanced Deep Learning

Computational Science	We conduct education and research on designing, implementing, and using mathematical models, numerical analysis, and numerical simulations to analyze and solve scientific problems.	Prof. Toshihiro Kawaguchi Associate Prof. Takayuki Haruki Assistant Prof. Takashi Horiuchi	Advanced Cosmic Science Informatics Advanced Computational Science Advanced Cosmic Science Informatics
Mathematical Analysis	In order to respond to the rapid development of state-of-the-art technologies such as computers and communication technologies, we actively conduct research on information mathematical science from a position to analyze the mathematical models and mathematical rules underlying them, and conduct education on representation theory, nonlinear analysis and stochastic process. We also aim to cultivate experts with the ability to analyze mathematical phenomena making full use of computers; such experts would be able to perform research and development that are necessary for running advanced information of the science and technology society.	Prof. Hiroyuki Yamane*1 Prof. Masato Kikuchi*2 Prof. Keiichi Ueda Specially Appointed Prof. Katsuhiko Sato Associate Prof. Hideo Deguchi Associate Prof. Masakazu Akiyama Assistant Prof. Ken Furukawa	Advanced Representation Theory Advanced Stochastic Process Advanced Computational Mathematics Advanced Mathematical Mechanics Advanced Mathematical Phenomenal Analysis Advanced Mathematical Sciences Based on Modeling and Analysis Advanced Topics in Applied Analysis
Mathematical Structural Science	We conduct education and research on the basic theory of mathematical science that supports the society depending on the complex and advanced science and technology, search for reliability in a comprehensive manner, and explore methods of mathematical analysis for mathematical phenomena. We also aim to cultivate specialists who excel in mathematical thinking and logic-composing by deepening their ability to analyze mathematical structures.	Prof. Keiko Fujita Prof. Takashi Koda*2 Associate Prof. Tatsuya Kawabe Associate Prof. Iwao Kimura Assistant Prof. Yuki Shimizu Assistant Prof. Naoki Genra	Advanced Complex Analysis Advanced Geometry Advanced Theory of Geometric Structures Advanced Number Theory Advanced Representation Theory
Quantum Information	We are working on quantum information theory where application of quantum mechanics offers revolutionary improvements to information processing. Our interest includes proposal of quantum cryptographic protocols and side-channel attacks against them, security analyses of quantum protocols, and analyses of quantum repeaters.	Prof. Kiyoshi Tamaki Associate Prof. Akihiro Mizutani	Advanced Quantum Information Processing Advanced Quantum Computing
Quantum Control Theory	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.	Specially Appointed Prof. Koji Maruyama	Information Thermodynamics
Computer Vision	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).	Specially Appointed Prof. Chao Zhang	Advanced Topics in Computer Vision

(2) Life, Material and Energy Sciences Program

Our course offers a wide range of research fields including life and material chemistry, advanced clean energy, physics and applied physics which are keys to modern science and technology and indispensable for our future. Students will acquire skills and knowledge, both basic and applied, through reading academic articles, giving scientific reports, and participating in conferences and symposiums as well as communications among researchers and research fields. We are proud of producing highly innovative graduates.

Educational field	Education and Research	Supervisors	Related lectures
Cellular Electrical Engineering	As an interdisciplinary field combining cell engineering and electrical engineering, we conduct education and research on applications such as single-cell analysis and cell separation utilizing the phenomenon of alternating current electrophoresis.	Junior Associate Prof. Minoru Suga	Advanced Lecture on Biological Dielectric Phenomena
Molecular and Cellular Bioengineering	Education and research will be conducted on the development of monoclonal antibodies for diagnostic and therapeutic use, as well as on the functional analysis of biomolecules using antibodies and their application in biotechnology. Education and research will be conducted to elucidate the mechanism of protein metabolism in vivo and develop artificial regulation methods of protein metabolism. Education and research will be conducted to develop material production processes by bioreaction engineering using microorganisms and to elucidate their microbial cellular mechanisms. Education and research will be conducted to deepen our understanding of life using synthetic biology techniques, which aim to artificially build life and biological systems by reconstituting biological molecules, and apply this knowledge to various fields, such as environmental issues and advancing healthcare.	Prof. Nobuyuki Kurosawa *2 Prof. Tatsuhiko Ozawa Associate Prof. Tomonao Inobe Junior Associate Prof. Seiichi Koike Assistant Prof. Maki Moriwaki	Advanced Course in Antibody Engineering Advanced Course in Protein Metabolism Advanced Course in Immune Engineering Advanced Course in Microbial Reaction Engineering Advanced Course in Synthetic Cell Biology
Pharmacology	Education and research will be conducted on intractable chronic pain diseases such as postherpetic neuralgia, migraine, and cancer pain, and intractable chronic pruritic diseases such as atopic dermatitis, in order to elucidate their pathological mechanisms and to discover novel therapeutic agents.	Associate Prof. Ichiro Takasaki	Advanced Pharmacology and Genetic Engineering
Medicinal Chemistry	Research and education on drug discovery research, including synthetic studies of natural products exhibiting unique biological activities and design, synthesis, and structure-activity relationship studies of novel drugs based on small organic molecules.	Associate Prof. Takuya Okada	Advanced Bioorganic and Medicinal Chemistry
Condensed Matter Physics	We perform education and research on the relationship between atomic-level structure of materials and their physical properties. Emphasis is placed on the understanding transition mechanism via advanced experimental method for metallic, semiconducting, magnetic and superconducting materials. Methods of structural analysis such as X-ray diffraction and X-ray absorption spectroscopy, computational analysis and experimental techniques for physical transport properties will be introduced to proceed with the education and researches.	Prof. Tomohiko Kuwai*2 Associate Prof. Takashi Tayama Associate Prof. Keisuke Hatada Assistant Prof. Yuji Matsumoto	Advanced Condensed-Matter Physics Advanced Low Temperature Physics Transport Properties of Advanced Materials Advanced Strength of Materials

Energy Material Basic Science	We conduct wide-ranging education and research about what is a basic material, what kind of forces are working between the materials, how the Universe has been formed and developed and what mathematical expressions are appropriate for ultimate theories of material, time and space.	Associate Prof. Mitsuru Kakizaki Assistant Prof. Yuuki Nakano	Advanced Relativistic Cosmology
Molecular Energy Basic Science	We conduct education and research to identify molecular spectra and to derive precise molecular structures. These are important for physical chemistry, astronomy and environmental science by using laser and microwave spectroscopy. Techniques of trapping and cooling of atoms and molecules are also investigated and are applied to determine the precise frequencies and to verify the parameters of fundamental physics. We are also developing KAGRA, gravitational wave detector at Kamioka (Gifu prefecture), especially, technologies related with laser and mirror.	Prof. Yoshiki Moriwaki Prof. Kaori Kobayashi Associate Prof. Katsunari Enomoto Associate Prof. Kazuhiro Yamamoto Assistant Prof. Mai Takeo	Advanced quantum electronics Advanced Microwave Molecular Spectroscopy Advanced Molecular Spectroscopy Advanced Gravitational Wave Physics
Materials Science for Electronic Devices	We conduct education and research on nanodevices and MEMS (micro-electro-mechanical systems), as well as integrated circuits utilizing these technologies, including semiconductor thin films and superlattice heteroepitaxial growth and their electronic properties. In addition, we investigate collective ordering phenomena and emergent physical properties in ferroelectrics driven by crystal growth, structural phase transitions, and polarization reversal.	Prof. Masayuki Mori Associate Prof. Toshio Kikuta	Advanced Semiconductor Thin Film Technology Ferroelectric Devices
Organic Optoelectronic Devices Engineering	We conduct education and research in the optoelectronics, thin-film engineering, alignment controlling, and application of optoelectronic devices using organic semiconductors.	Prof. Shigeki Naka	Advanced Organic Electronic Device
Material Design	We perform education and research on the relationship between electronic/atomic structure of materials and their mechanical/physical properties. Emphasis is placed on the understanding deformation mechanism via advanced deformation method and the development of new functions via micro/nano-structure control, surface modification, or control of phase transformation/precipitation with metallic, ceramic, magnetic and superconducting materials. Electron microscopy, computational analysis and experimental techniques for physical transport properties will be introduced to proceed with the education and researches.	Prof. Kenji Matsuda*2 Prof. Norio Nunomura*2 Associate Prof. Takahiro Namiki Associate Prof. Seungwon Lee	Advanced Nano material Structural Analysis Advanced Computational Materials Modelling Transport Properties of Advanced Materials Advanced Strength of Materials
Materials Chemistry	Education and research are conducted into the fundamentals and applications of smelting, refining, and recycling processes of inorganic materials, mainly metals, by dry and wet methods.	Prof. Hideki Ono Prof. Satoru Murata*2	Advanced Refining Engineering of Materials
Plasma Science	Nonlinear and nonequilibrium phenomena of plasmas (such as nonlinear waves, turbulence, generation processes of non-thermal particles, and so on), and application of mathematical modeling	Prof. Yasuhiro Nariyuki	Plasma Astrophysics
Atomic and Molecular Physics	Education and research on the physics of fundamental processes in the interaction of high-energy photon with atoms and molecules will be carried out through experimental studies of photoionization processes of atoms and molecules using synchrotron radiation.	Prof. Yasumasa Hikosaka Associate Prof. Hayato Ohashi	Advanced Atomic and Molecular Physics Advanced Highly-charged Ion Physics

High Frequency Engineering	We conduct education and research on mobile communication systems, regarding multipath radio propagation, adaptive signal processing using array antennas and its over-the-air testing method, and angle of arrival estimation.	Associate Prof. Kazuhiro Honda	Advanced Radio Wave Propagation
Photofunctional Material	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.	Prof. Yutaka Takaguchi	Advanced Photofunctional Material
Biomaterials Processing and Engineering	Education and research into the physico-chemical properties of biomaterials for tissue engineering and processing techniques for biomaterials at the nano- and micro-scale.	Assistant Prof. Shintaro Iwanaga	Advanced Biomedical Engineering
Particle Design Process	We conduct education and research on particle design for creation of high-functional new materials accompanied by generation of fine powder and advanced technologies for development and design of their industrial manufacturing process.	Associate Prof. Taketoshi Kurooka Assistant Prof. Guiqing Liu	Advanced Process Analysis Selected Topics in Chemical and Environmental Process
Nanomaterials Chemistry	We conduct education and research on synthesis and fabrication of photo-functional nanomaterials for light energy conversion and development of novel functions.	Junior Associate Prof. Hiroyasu Nishi	Advanced Photo-Functional Materials Chemistry
Photofunctional Molecular Science	We conduct educational research on elucidating reaction dynamics and excited-state structures for the photo-functional molecules converting light energy into chemical energy or electrical energy, especially the photo function of molecular systems containing heavy metals such as transition metal complexes, developing observation and analysis methods.	Junior Associate Prof. Munetaka Iwamura Assistant Prof. Tsukasa Takanashi	Photochemistry of Transition Metal Complexes
Synthetic Coordination Chemistry	We conduct education and research on synthesis, structures, and physical and chemical properties of mono- to multi-nuclear coordination compounds with various properties including luminescence, redox activity, and response to external stimuli.	Prof. Kiyoshi Tsuge Associate Prof. Hideki Ohtsu Associate Prof. Honoo Suzuki *	Advanced Synthetic Coordination Chemistry Advanced Functional Coordination Chemistry Advanced Structural Solution Chemistry
Synthetic Organic Chemistry	We conduct education and research on the design and synthesis of novel extended pi-conjugated systems, their application to supramolecular functional materials, the development of novel organic reactions, and their applications to the synthesis of biologically active natural compounds.	Prof. Naoto Hayashi Junior Associate Prof. Hajime Yokoyama Assistant Prof. Junro Yoshino	Advanced Organic Nano Science Advanced Synthetic Natural Products Chemistry Advanced Organo-Main Group Element Chemistry
Biofunctional Chemistry	Elucidation of the molecular bases of naturally occurring RNAs acting as enzymes and receptors. Generation of novel structures and functions of artificial RNA molecules, assembly of these RNA molecules to construct RNA-based molecular systems.	Prof. Yoshiya Ikawa Junior Associate Prof. Shigeyoshi Matsumura	Advanced Bimolecular-System Science Evolutionary Molecular Engineering
Organic Electrosynthesis	Our focus is on developing new synthetic reactions for nitrogen-containing compounds using an electrochemical approach.	Assistant Prof. Kazuhiro Okamoto	

Environmental and Analytical Chemistry	Education and research will be conducted into the development of new separation materials and methods for efficient separation and concentration of trace elements contained in solutions, and their applications in analytical and environmental chemistry, such as determination of trace and ultra-trace elements in environmental and biological samples, recovery of valuable elements in waste, and removal of hazardous elements from waste.	Prof. Shigehiro Kagaya Associate Prof. Makoto Genmei Assistant Prof. Akira Kanno	Advanced Separation Science for Trace Element Advanced Biointerface Science Advanced Analytical Chemistry for Living Organisms
Computational Biomolecular Science	We construct an interaction model for biomolecules based on quantum chemical principles and analyze their molecular structure and dynamics through computer simulation technique. By calculating static and dynamic physical quantities based on statistical mechanics theories from the molecular trajectories obtained through molecular simulations, we elucidate biological phenomena at the molecular level.	Associate Prof. Tatsuya Ishiyama	Biomolecular Simulation
Nanobiomolecular Engineering	The aim of our research is to understand the chemical and molecular mechanism of biological activities, and to develop new bio-sensing methods.	Associate Prof. Masafumi Sakono	Advanced Biofunctional Engineering
Nano-Biomaterial Design	Research theme of this field is that 1) design and synthesis of functional molecules, biopolymers, and proteins for constructing biomedical devices, and 2) development of novel functional biomaterials using biopolymer, protein and functional molecules. Additionally, we aim to elucidate and understand the correlation between biomaterial and biomolecules such as cell, protein, bacteria etc. Various information obtained by various in vitro and in vivo experiments will be used to develop biomedical devices that can be used in practical applications.	Associate Prof. Tadashi Nakaji	Lecture for Development of Nanomaterials and Biomaterials
Synthetic Inorganic Chemistry	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.	Associate Prof. Akira Miyazaki	Advanced Properties of Molecular Solid-State Materials
Process Chemistry for Pharmaceuticals	Education and research on the development of efficient synthetic methods for biologically active compounds, including pharmaceuticals, and various functional organic molecules.	Prof. Hitoshi Abe *1	Advanced Synthetic Chemistry of Functional Molecules
Energy Environment Science	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.	Associate Prof. Hidehisa Hagiwara Prof. Masanori Hara Junior Associate Prof. Akira Taguchi Assistant Prof. Satoshi Akamaru	Energy Conversion Engineering Advanced Lecture for Measurement and Detection of Radiation Advanced Catalytic Transformation Advanced Inorganic Functional Materials
Molecularreaction Engineering	We aim to solve energy and environmental problems for the foundation of a future society by making full use of knowledge about catalytic chemistry, chemical reaction engineering, and molecular dynamics. Our study focuses on advanced application of resources such as	Prof. Noritatsu Tsubaki Associate Prof. Guohui Yang Specially Appointed	Advanced Catalysis Engineering

	biomass, carbon dioxide, green hydrogen and sun-light, as well as chemical reaction and chemical engineering processes that pose low environmental burdens. It also explores nano-materials with novel functions.	Associate Prof. Shuhei Yasuda Specially Appointed Junior Associate Prof. He Yingluo	
--	---	--	--

(3) Sustainable Global Environmental Studies Program

We conduct education and research on the past, present, and future history and changes of the atmosphere, hydrosphere, geosphere, and biosphere that make up the Earth's environment, as well as their interactions, from the earth's interior to outer space, to develop human resources with interdisciplinary knowledge and thinking ability. Specifically, education and research are conducted on the structure, behavior, evolution, and diversity of organisms in the Earth's environment, and the mechanisms of transmission, expression, and regulation of genetic information. Based on the knowledge obtained from these studies, we conduct education and research on (1) genetic engineering for the industrial production of useful materials, (2) analysis of the relationship between biological functions and the internal and external environment, (3) conservation and restoration of the environment using chemical and biological methods, (4) changes in the crustal structure, (5) prediction of natural disasters, and (6) disaster prevention technology. Furthermore, we also work on issues aimed at the formation of a sustainable society.

Educational field	Education and Research	Supervisors	Related lectures
Geological Science	We conduct education and research for unveiling the origins of underground resources and changes in the global environment during 4.6 billion years of the Earth history. The primary targets of our study are solid substances that record the Earth history such as minerals, rocks, and sedimentary strata. From the targets, we explore the material cycle, chemical reaction, heat history, and environmental changes of the Earth from its birth to the present on the basis of accurate age dating.	Prof. Yasuo Ishizaki Prof. Shin-ichi Sano Associate Prof. Ken-ichi Yasue Junior Associate Prof. Ai Kawamura Assistant Prof. Hikaru Sawada Assistant Prof. Toru Nakajima	Advanced volcanology Earth and Life History Advanced Neotectonics Vertebrate Paleontology Advanced Earth Material Science Advanced Orogenic Geology
Geophysics of Atmosphere, Ocean, and Cryosphere	As global warming progresses, extreme weather events are becoming more severe and frequent. The Hokuriku region is also affected by these significant climate changes, facing increased risks of various local disasters such as heavy snowfall, thunderstorms, heatwaves, and storm surges. To protect safe urban functions and rich social life from these risks, we aim to study the mechanisms behind climate system changes from a global perspective and develop highly capable individuals who can apply this knowledge to solve local problems.	Prof. Kazuaki Yasunaga Prof. Kazuma Aoki Prof. Konosuke Sugiura Prof. Bunmei Taguchi Prof. Masahiro Hori Associate Prof. Wataru Shimada Associate Prof. Atsushi Hamada	Advanced Dynamic Meteorology Advanced Atmospheric Radiation Advanced Geoglaciology Advanced Ocean and Climate Dynamics Advanced Remote Sensing Advanced Snow and Ice Science Advanced Atmospheric Physics

Solid Earth Geophysics	Our education and research are aiming to advance our understanding of the structure of the solid Earth and its dynamics, especially around the Central Japan. We are investigating the crustal structure, seismic and volcanic activities, and environmental changes in this area through geophysical observations, field surveys, and laboratory experiments. Students are trained to contribute to the prediction, prevention and mitigation of natural disasters..	Prof. Tohru Watanabe Associate Prof. Kazuo Kawasaki Junior Associate Prof. Kohei Hotta	Advanced Physics of the Earth's interior Advanced Resource and Environmental Geophysics Advanced Geodesy
Regulatory Biology	Education and research are conducted on adaptive significance of biological rhythms and sleep system, endocrine system, and behavioral system of an individual organism or population in changing external environments.	Prof. Kouhei Matsuda Prof. Masayuki Ikeda Prof. Kimiko Shimizu Prof. Tomoko Yoshikawa Junior Associate Prof. Norifumi Konno Junior Associate Prof. Tomoya Nakamachi Junior Associate Prof. Eri Morioka	Advanced Biochemistry for Organic Molecules Advanced Topics in Sleep Physiology Advanced Topics in Chronobiology Advanced Biological Clocks Advanced Endocrinology Advanced Behavioral Physiology Advanced Invertebrate Neuroethology
Life Information Science	We study the molecular mechanisms underlying cell differentiation and organ development, as well as genome structure, inheritance, and gene expression in diverse plant species. We also investigate how plants perceive, transduce, and respond to environmental and endogenous signals, including light and hormones.	Prof. Ichirou Karahara Specially Appointed Associate Prof. Tomoaki Nishiyama Junior Associate Prof. Masayuki Yamamoto Junior Associate Prof. Daisuke Tamaoki	Advanced Plant Morphology Advanced Plant Molecular Genetics Advanced Plant Cell Biology
Living Structure Science	We analyze various processes in the biological developments, morphogenesis, structural features, phylogenetic relationships, diversity, behavioral ecology and evolution through comparative study in living structures. Thus, we conduct education and research to understand the fundamental principles and rules.	Associate Prof. Yuji Yamazaki Associate Prof. Kiyoto Maekawa Associate Prof. Tsutomu Tsuchida Assistant Prof. Kyoko Sato Assistant Prof. Gohta Kinoshita	Living Structure Science Advanced Evolutionary Developmental Biology Advanced Biology of Symbiosis Advanced Plant Cytotaxonomy
Environmental and Analytical Chemistry	Our group focuses on exploring techniques from chemical approaches in solving and clarifying environmental problems. For example, we are developing simple and rapid analytical methods to measure harmful components related to environmental pollution. The dynamics of these components are then studied, and based on these findings, we perform basic research to remove the pollutants from waste water. Furthermore, our research also includes geochemical monitoring of CO ₂ which consists of water rock interaction in geothermal fields. We also clarify and evaluate material cycling systems and mechanisms and changes in oceanic and terrestrial water systems, using major ions, trace elements, and stable isotopes.	Prof. Jing Zhang Prof. Hideki Kuramitsu Prof. Keiji Horikawa Junior Associate Prof. Kazuto Sazawa Junior Associate Prof. Takanori Kagoshima Specially Appointed Assistant Prof.	Advanced Marine Geochemistry Advanced Water Analysis Isotope Studies in Environmental Science Advanced Environmental Water Quality Advanced Solid Earth Geochemistry

		Hidetaka Kobayashi	Advanced Ocean Dynamics
Environmental Biology	We conduct research on the functions of organisms, which are important components of the biosphere, from the molecular to ecosystem level. In particular, education and research will be conducted on the effects of environmental factors such as light, water, metal ions, and chemical substances on the physiological functions of organisms, the effects of global environmental change, and interactions between individual organisms and between species.	Prof. Daisuke Tanaka	Advanced Microbiology
		Prof. Hiroshi Ishii	Advanced Plant Ecology
		Associate Prof. Hiroyuki Kamachi	Advanced Plant Physiology
		Associate Prof. Kenji Kashiwagi	Advanced Stratigraphy
		Junior Associate Prof. Akihiro Sakatoku	Advanced Environmental Molecular Biology
Environmental Sustainability Science	Our group's primary focus is advancing environmental sustainability through rigorous research that emphasizes the conservation and responsible management of natural ecosystems, including land use land cover (LULC) and forestry, agricultural landscapes, plantations, coastal and marine seascapes, and urban green spaces. We mentor Ph.D. candidates in exploring methodologies for protecting, restoring, maintaining, and sustainably using ecological systems. Our research includes detailed analysis of land-use practices and ecosystem services in environmental systems such as freshwater and marine fish habitats, water resources, and agroecosystems from a sustainability science point of view. Additionally, we develop and implement sustainable management frameworks designed to ensure the long-term viability and resilience of environmental systems.	Junior Associate Prof. Tamihisa Ohta	Advanced Isotope Ecology
		Prof. Naoya Wada	Advanced Conservation Ecology
		Prof. Geetha Mohan	
		Associate Prof. Chakraborty Shamik	
		Assistant Prof. Shishir Sharmin	
Assistant Prof. Peterson Miles Isao			

(4) Advanced Engineering Program

Education and research are conducted in the fields of mechanical engineering, electronics, robotics, materials science, and civil engineering to develop human resources with broad knowledge and specialized skills in engineering fields and the ability to solve problems in a sustainable society. Specifically, education and research will be conducted in the following fields and also aim at exchanges among the fields: a wide range of fields that integrate electronic and electrical engineering and mechanical engineering, with an understanding of natural sciences such as electromagnetism and various dynamics, the creation of a foundation for industrial and technological innovation through material innovation based on material science, and the design of safe, secure and comfortable cities through the advanced use of data science.

Educational field	Education and Research	Supervisors	Related lectures
Organic Optoelectronic Devices Engineering	We conduct education and research in the optoelectronics, thin-film engineering, alignment controlling, and application of optoelectronic devices using organic semiconductors.	Prof. Shigeki Naka	Advanced Organic Device
		Prof. Masahiro Morimoto	Advanced Organic Thin Films
High Frequency Engineering	We conduct education and research on mobile communication systems, regarding multipath radio propagation, adaptive signal processing using array antennas and its over-the-air testing method, and angle of arrival estimation.	Associate Prof. Kazuhiro Honda	Advanced Radio Wave Propagation

Materials Science for Electronic Devices	We conduct education and research on nanodevices and MEMS (micro-electro-mechanical systems), as well as integrated circuits utilizing these technologies, including semiconductor thin films and superlattice heteroepitaxial growth and their electronic properties. In addition, we investigate collective ordering phenomena and emergent physical properties in ferroelectrics driven by crystal growth, structural phase transitions, and polarization reversal.	Prof. Masayuki Mori Associate Prof. Toshio Kikuta	Advanced Semiconductor Thin Film Technology Ferroelectric Devices
Material Design	We perform education and research on the relationship between electronic/atomic structure of materials and their mechanical/physical properties. Emphasis is placed on the understanding deformation mechanism via advanced deformation method and the development of new functions via micro/nano-structure control, surface modification, or control of phase transformation/precipitation with metallic, ceramic, magnetic and superconducting materials. Electron microscopy, computational analysis and experimental techniques for physical transport properties will be introduced to proceed with the education and researches.	Prof. Kenji Matsuda*2 Prof. Norio Nunomura*2 Associate Prof. Takahiro Namiki Associate Prof. Seungwon Lee Assistant Prof. Taiki Tsuchida	Advanced Nano Material Structural Analysis Advanced Computational Materials Modelling Transport Properties of Advanced Materials Advanced Strength of Materials Advanced Materials Fabrication Engineering
Materials Chemistry	Education and research are conducted into the fundamentals and applications of smelting, refining, and recycling processes of inorganic materials, mainly metals, by dry and wet methods and into the improvement of corrosion resistance, surface modification, and surface functionality by electrochemical methods.	Prof. Hideki Ono Associate Prof. Masahiko Hatakeyama Junior Associate Prof. Kengo Kato	Advanced Refining Engineering of Materials Advanced Chemical Analysis
Photofunctional Material	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.	Prof. Yutaka Takaguchi Assistant Prof. Katsuhiro Tanaka	Advanced Photofunctional Material
Material Process	Various theories and technologies have been established in the creation and application processes of excellent new materials and functional materials, and in the molding of metals. Education and research are conducted on the industrial application of molecular functional materials.	Prof. Seiji Saikawa * Prof. Tetsuo Aida Associate Prof. Takashi Hashizume	Advanced Material Forming and Engineering Advanced Material Manufacturing and Plasticity Theory Advanced Hydrothermal Processing for Inorganic Materials
Materials for Biofunctionalization	Education and research will be conducted into the design of artificial materials from the viewpoints of both macroscopic shape and microscopic material properties, not only to improve the functionality and performance of the material itself, but also to improve the functionality of the living body through the application of the material.	Prof. Takuya Ishimoto Assistant Prof. Tomoyo Manaka	Advanced Biomaterials Engineering
Transfer phenomenon system	We conduct education and research on transport phenomena of momentum, heat and mass occurring in industrial manufacturing processes such as polymer coating and alloy casting, aiming to develop mathematical models for simulation of unit operations constituting a process, methods for optimization of operating conditions, and technologies for saving energy and cost.	Associate Prof. Masamichi Yoshida *	Theory of Transport Phenomena

Molecular Mechanical Engineering	We conduct education and research on molecular dynamics and quantum mechanics for new materials as well as on the evaluation of mechanical function and performance of molecular devices including electronic ones.	Prof. Takeshi Seta Junior Associate Prof. Tatiana N. ZOLOTOKHINA *2	Advanced Computational Thermo-Fluid Dynamics Advanced Nano Dynamics
Strength and Fracture of Engineering Materials	We conduct education and research on establishment of optimal and safe design methods for mechanical components and structures. We also focus on creation and application of new functional materials through understanding the strength and fracture mechanisms of engineering materials, establishment of database for material properties, and reliability analysis.	Prof. Noriyasu Oguma *1 Associate Prof. Koichi kasaba Associate Prof. Kenichi Masuda	Advanced Mechanical Engineering Design for Special Environments Strength and Properties of Advanced Functional Materials Advanced Nonlinear Structural Analysis
Function Control Engineering	The functions of high-speed, high-precision and complex systems range from non-bio to bio functions and have become subdivided. We conduct education and research to develop elements and systems for measurement. We also focus on control systems that can efficiently deal with high functionalization and multi-functionalization as well as establishment of the theories.	Prof. Tohru Sasaki Prof. Kenji Hirata Prof. Yoshiyuki Matsumura Prof. Toshiyuki Yasuda Associate Prof. Kenji Terabayashi Associate Prof. Junya Yamauchi Junior Associate Prof. Masahiro Sekimoto Junior Associate Prof. Tomaru Takenori	Advanced Measurement System Decentralized and Cooperative Control Systems Advanced Intelligent System Advanced Adaptive Systems Advanced Image Measurement Advanced Learning-Based Control Advanced Robot Dynamics and Control Theory Advanced complex systems science
Material Processing	We conduct education and research on processing systems that not only improve the level of processing technologies and processing quality but also respond to superprecision and miniaturization by developing processing methods for new materials with multiple functions and elucidate their processing mechanisms.	Prof. Tomomi Shiratori Junior Associate Prof. Noboru Takano	Advanced Plasticity Process Advanced Microfabrication
Solid Mechanics	On the basis of mechanics such as studies on the strength of materials, computational mechanics, and experimental mechanics, we perform education and research on the strength of new materials, their combined materials, and functional materials. We also carry out mechanical evaluation of machine, components, and structures.	Prof. Katsuyuki Kida Associate Prof. Koshiro Mizobe Assistant Prof. Soji Matsubayashi	Advanced Solid Mechanics Advanced Fracture Mechanics
Intelligent Systems	We conduct education and research on robotics, medical robotics system, rehabilitation systems, intelligent algorithms, and intelligent control.	Associate Prof. Hideki Toda	Biosignal Measurement and Processing for Robot Application
Bio-Information Engineering	We conduct education and research which promote design and development of the method of measuring biological information and the method of analyzing biological information for estimating a biological state.	Prof. Kazuki Nakajima*1	Advanced Bio-Instrumentation Engineering
Ultra-High Frequency Engineering	We conduct education and research on electromagnetic simulation, device fabrication and measurement, and signal and image processing. Furthermore, we conduct education and research on imaging in the millimeter and terahertz wave regions.	Prof. Seiichiro Ariyoshi Associate Prof. Masafumi Fujii	Advanced Ultra-High Frequency Engineering Advanced FDTD Analysis

Electric Energy System	We conduct educational and research activities focused on the high-efficiency conversion of electrical and mechanical energy, as well as high-voltage and high-current technologies, including advanced high-power electronics, magnetic suspension technology, motor and actuator technology, pulsed power technology, high-power pulsed particle beam technology, applications ranging from atmospheric pressure plasma to high-density plasma, and the observation and prediction of lightning discharges.	Prof. Hiroaki Ito Prof. Takahisa Ohji Associate Prof. Kenji Amei Associate Prof. Masayuki Kato	High Voltage and High Current Engineering Advanced Electromagnetic Engineering Advanced Power Conversion Engineering Advanced Actuator Engineering
Thermofluid System	Our research in fluid and thermal sciences has both fundamental and applied studies in energy conversion, heat and mass transport, and technologies for their usage. Basic research efforts in energy systems include multiphase flows, coherent turbulent structure, and bioengineering.	Prof. Seiichiro Izawa Junior Associate Prof. Atsushi Kase Junior Associate Prof. Daisuke Watanabe	Turbulent Flow and Transport Advanced Applied Fluid Engineering Advanced Applied Fluid Engineering
Design Management	<ul style="list-style-type: none"> ▪ 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) 	Prof. Yoshiaki Kubota Assistant Prof. Yongcheng Wang	Advanced Design for Urban Spaces
Reliability Design on Geotechnical Structure	Education and research of reliability design on geotechnical structure from the viewpoints, heterogeneous characteristics of natural ground, uncertainties of subsurface exploration and resistance evaluation of geotechnical structure, is conducted.	Associate Prof. Naoki Tatta	Special Lecture of Geotechnical Structure Design
Infrastructure Planning and Management	Education and research on the following points will be conducted. -Social impact assessment of public transportation development. -Methods of public participation in transportation and urban planning. Evaluation of its effectiveness. -Analyze the impact of disasters on transportation and propose countermeasures. -Evaluation of transportation nodes and pedestrian spaces.	Associate Prof. Hiroto Inoi Junior Associate Prof. Qiang Liu	Advanced Urban and Transportation Planning
Structural Mechanics and Bridge Engineering	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.	Associate Prof. Yasuo Suzuki	Advanced Bridge Engineering
Properties of Interfacial Materials	We conduct education and research on the novel material properties that emerge at interfaces such as those between two-dimensional materials and metals, and between oxides and metals.	Prof. Hiroshi Naganuma	Advanced Topics in the Physical Properties of Interfacial Materials