# GUNMA UNIVERSITY
## School of Science and Technology
## Graduate School of Science and Technology

群馬大学
GUNMA UNIVERSITY

School of Science and Technology
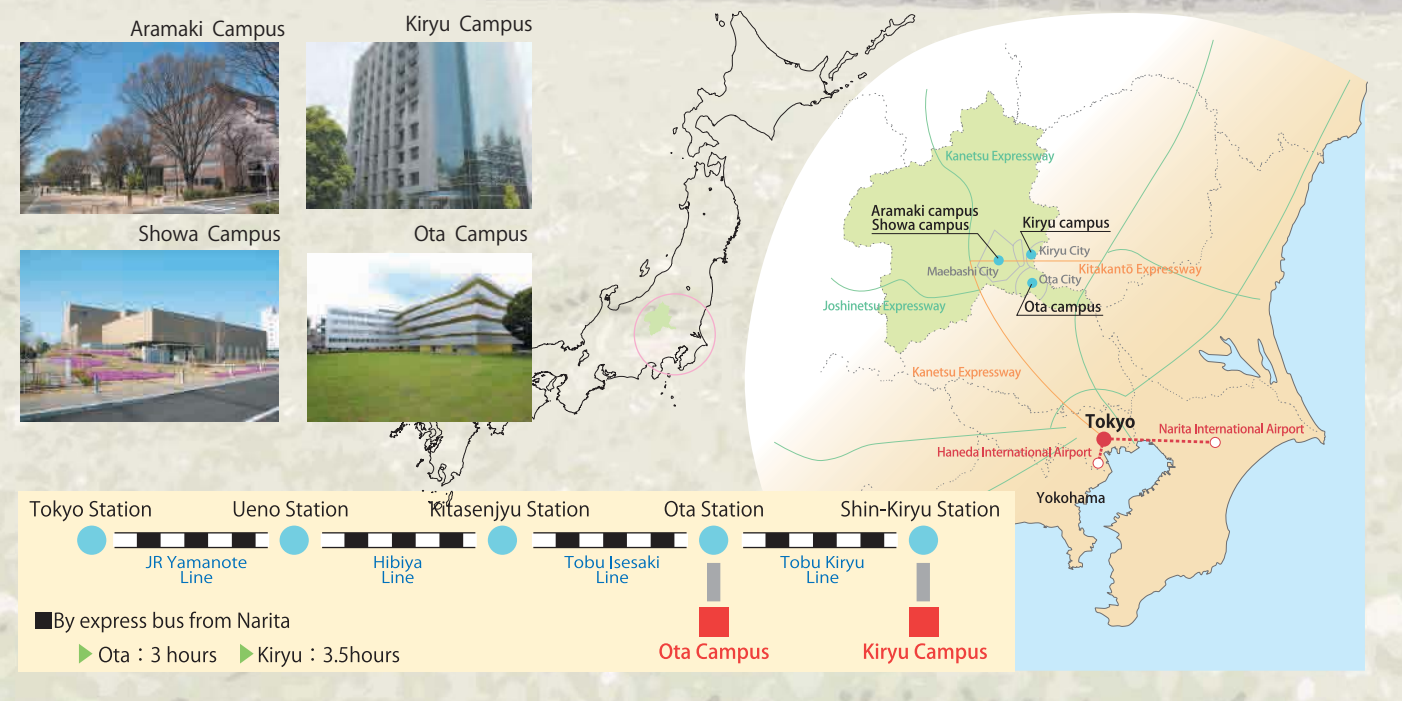Graduate School of Science and Technology
**Gunma University**

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http://www.st.gunma-u.ac.jp/
+81-277-1023  t-gakuseisien@jimu.gunma-u.ac.jp

# Hand Crafting Our Future

## Access

Aramaki Campus

Kiryu Campus

Showa Campus

Ota Campus

Kanetsu Expressway

Aramaki campus
Showa campus

Kiryu campus

Kiryu City

Maebashi City

Ota City

Kitakantō Expressway

Joshinetsu Expressway

Ota campus

Kanetsu Expressway

Tokyo

Narita International Airport

Haneda International Airport

Yokohama

| Tokyo Station | Ueno Station | Kitasenjyu Station | Ota Station | Shin-Kiryu Station |
|---|---|---|---|---|
| | JR Yamanote Line | Hibiya Line | Tobu Isesaki Line | Tobu Kiryu Line |

■By express bus from Narita
▶ Ota：3 hours  ▶ Kiryu：3.5hours

Ota Campus

Kiryu Campus

Materials and Bioscience
Mechanical Science and Technology
Environmental Engineering Science
Electronics and Informatics, Mathematics and Physics

# Welcome to Gunma University School of Science and Technology!

Gunma University School of Science and Technology is located in Kiryu, Gunma Prefecture, an ideal learning environment close to nature and populated by warm and friendly people. The School's roots can be traced to the establishment of the Kiryu National Technical College of Textile Science in 1915. At that time, Kiryu was an important center of the Japanese textile industry, particularly the silk industry, and the college therefore consisted of two departments, namely, the Department of Chemistry and the Department of Mechanical Engineering, both of which made important contributions to the industrial endeavors in the Gunma vicinity at that time.

Since then, the college has expanded gradually, adding more departments such as electronics and chemical engineering. Following the end of World War II, the college was reestablished, as the Faculty of Engineering of the nascent Gunma University.

In 2013, the faculty instituted major reforms to meet the ever-changing demands of a modern technological society. Its seven existing departments were reorganized into four interdisciplinary departments. These departments offer students balanced educational programs of both basic science and advanced technology in interdisciplinary fields. Through this new system, we nurture engineers with a solid grounding in the natural sciences as well as a broad knowledge of modern technology.

The School of Science and Technology promotes and supports a variety of interdisciplinary research projects, for example, the "Element Innovation" project. This is a government-supported, 5-year multi-disciplinary research project carried out by researchers of various fields, including material science, machinery, electronics and even medical science. This collaborative work has resulted in several important scientific papers and patents. Furthermore, researchers at the school also contribute to the Program for Cultivating Global Leaders in Heavy Ion Therapeutics and Engineering, another government-supported project led by the Joint Project Office of the School of Medicine and the School of Science and Technology.

As you can see, a solid educational program and vibrant research projects await you. We hope you will join us and participate in these unique activities at the School of Science and Technology.

### Kazuo Shinozuka
Dean of the Graduate School of Science and Technology

## Contents

# 5 Great Reasons to Choose Gunma University

Here are five great reasons for you to consider studying at Gunma University while living in Japan.

## 1 Advanced technologies paving the way to the future

Gunma University is at the forefront of advanced technologies including the Element Innovation Project, and technologies related to low carbon, green innovation, disaster prevention research, and heavy ion radiotherapy.

## 2 Global Frontier Leadership Program

Gunma University conducts the Global Frontier Leadership (GFL) Program to nurture human resources to serve as leaders in their fields.

## 3 Student support services

Gunma University offers extensive support for international students to ensure they have a comfortable student experience. As well as initial moral support and language education, the university is also home to the Center for International Education Research.

## 4 A safe location where industry is growing

Gunma Prefecture is situated in a safe area of Japan with firm ground and a very low disaster risk. Students can therefore focus on their studies with peace of mind.
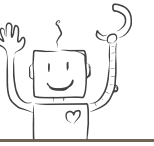
## 5 Superb seasonal changes and activities

Japan's has four distinctly beautiful seasons, and with its abundant nature, Gunma Prefecture is the perfect place to experience them. With plenty of activities to try, life in Japan is a lot of fun.
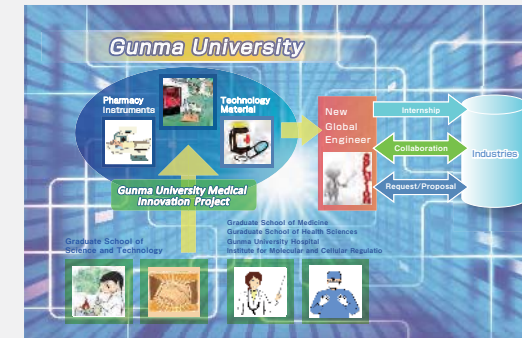
**RANKED IN THE TOP 3%**

There is so much to learn !
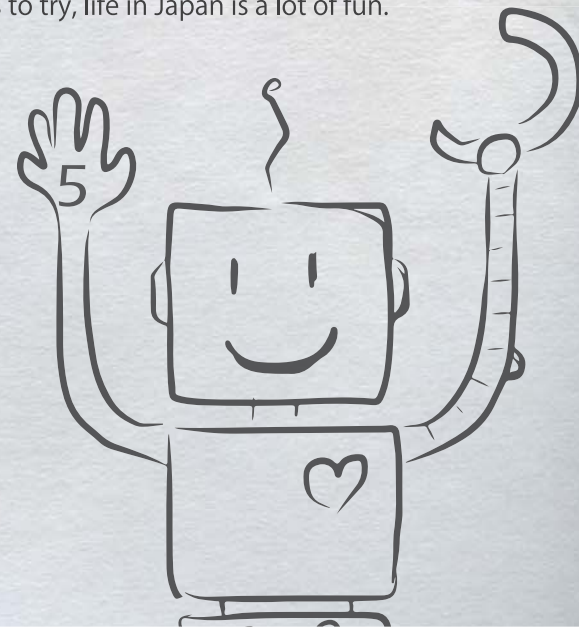
# Advanced technologies paving the way to the future

## Topics 1   Gunma University Medical Innovation



"Gunma University Medical Innovation Project" is a research project that started in 2014 with financial support from the Ministry of Education, Culture, Sports, Science and Technology of Japan. The main goals of the project are to develop new medical instruments, health monitoring devices, and diagnostic and cure medicines. Young students are educated to become a new type of global engineer with professional engineering skills as well as the ability to create new prospects comprehensively.

For more information ≫ P10-11

## Topics 2   International Research and Education Center for Element Science
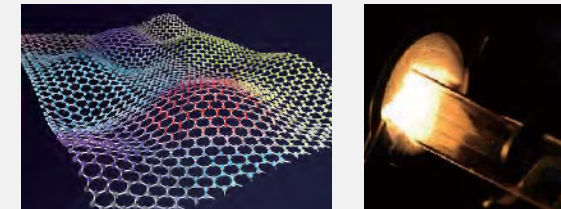


This newly founded center investigates advanced carbon materials and high-quality silicon compounds.

For more information ≫ P12

## Topics 3   Low-Carbon



Advanced research into carbon materials aims to realize a low-carbon society that uses hydrogen energy.

For more information ≫ P13

## Topics 4   Disaster Prevention Research



Prof. Katada's research group had been conducting tsunami disaster prevention education in elementary and junior high schools for several years, which effectively saved many school-age children from the huge tsunami in the Great East Earthquake.

For more information ≫ P14

## Topics 5   The Gender Equality Promotion Activities



Gunma University has adopted the Program to Support the Activities of Female Researchers (known as the "Mayudama Plan"). Under the plan, activities to promote joint participation in research by men and women are moving forward, led by the Gender Equality Office.

For more information ≫ P15

### An abundance of appealing research fields!

For more information ≫ P11 - P15

5 Great Reasons

# Global Frontier Leadership (GFL) Program
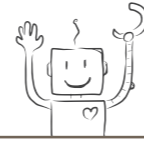
One of the pillars of Gunma University's educational philosophy is to cultivate students "who understand the culture, history, and tradition of their own country as well as other countries, who have communication skills in a foreign language, and who can assume a role of leadership in a global setting." For this reason, the Global Frontier Leadership Program, GFL, was created.

The program was established in 2013 through the cooperation of the Faculty of Medicine and the School of Science and Technology. Participants in the program can learn about many different cultures, hone their communication skills in both Japanese and a foreign language, and gain a broader international understanding. Finally, participants are required to study abroad at some time during their academic careers.

## Purpose

The Global Frontier Leadership (GFL) Program develops the following five areas:

① Independent inquiry in a specific theme or topic
② Broad knowledge supported by a deep understanding of areas of expertise
③ Ability to design a comprehensive plan with a clear purpose
④ Communication skills for international activity
⑤ Ability to carry out a plan as a team or an organization

## Program

In order to support the five areas above, the program includes the following educational programs (Fig.1).
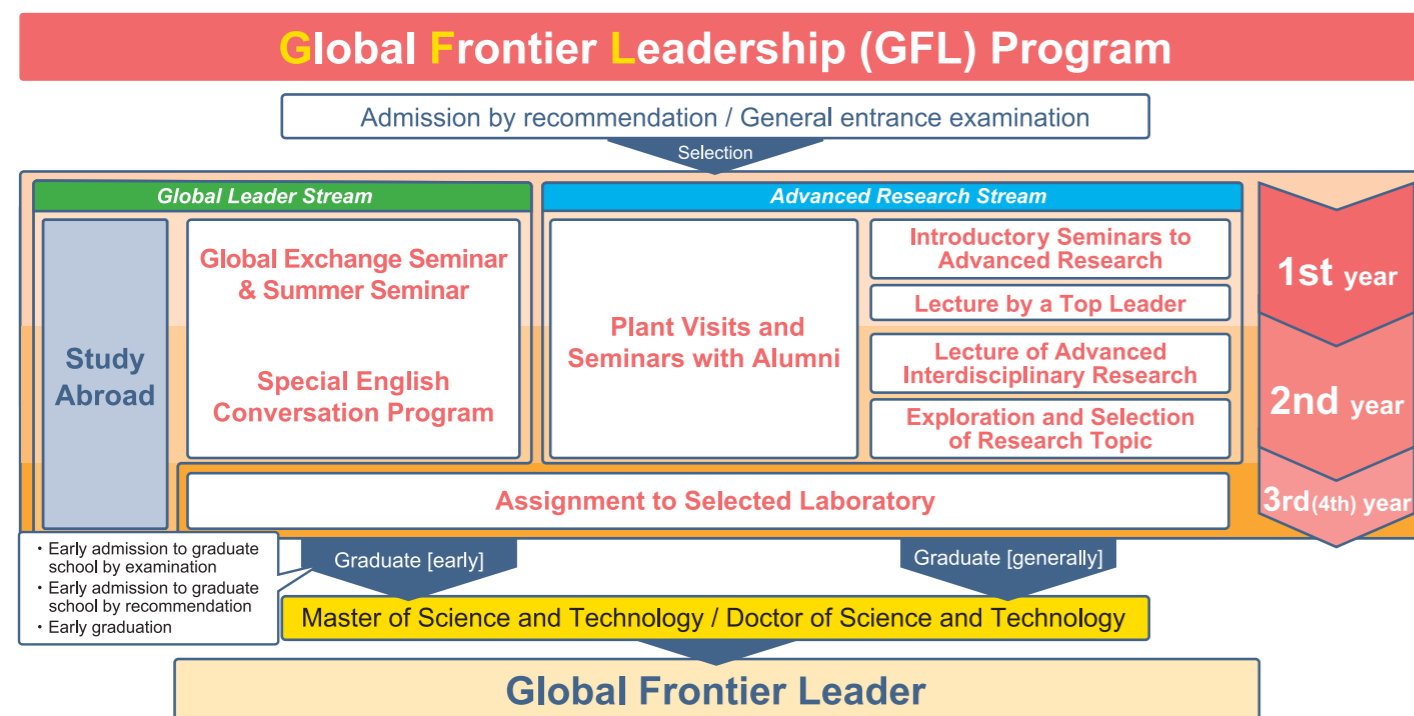
### Global Frontier Leadership (GFL) Program

Admission by recommendation / General entrance examination

Selection

| Global Leader Stream | Advanced Research Stream | | |
|---|---|---|---|
| Study Abroad | Global Exchange Seminar & Summer Seminar | Introductory Seminars to Advanced Research | 1st year |
| | | Lecture by a Top Leader | |
| | Plant Visits and Seminars with Alumni | Lecture of Advanced Interdisciplinary Research | 2nd year |
| | Special English Conversation Program | Exploration and Selection of Research Topic | |
| | Assignment to Selected Laboratory | | 3rd (4th) year |

・ Early admission to graduate school by examination
・ Early admission to graduate school by recommendation
・ Early graduation

Graduate [early]    Graduate [generally]

Master of Science and Technology / Doctor of Science and Technology

### Global Frontier Leader

Fig.1 Conceptual diagram of the Global Frontier Leadership (GFL) Program

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# Student Support Services
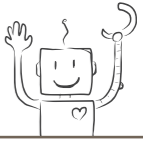
**Service 1** Center for International Education and Research

The Center for International Education and Research (CIER) promotes a comfortable living and studying environment for international students of Gunma University. CIER offers the following services.
1. Japanese language, Japanese culture, and current affairs
2. Preliminary Intensive Japanese Language Course for Japanese Government Scholarship Students
3. Counseling on daily life and studies
4. Advice for Japanese students intending to study abroad
5. Research activities on the education of international students and educational materials

**Service 2** Japanese language courses

Japanese language classes for international students are offered at various levels in order to help them pursue their academic goals. International students at Gunma University are encouraged to take Japanese classes in accordance with their individual levels. CIER offers two Japanese programs: Preliminary Intensive Japanese Language Courses for Japanese Government Scholarship Students and "Japanese Language & Japanese Studies." The classes are offered as elective liberal art subjects for registered undergraduate international students. Supplementary Japanese classes may be offered for graduate/research students.

| CIER Website | http://www.cier.gunma-u.ac.jp/english/ |
|---|---|

**Service 3** Student Support Section

The Student Support Section is committed to providing a supportive and positive environment for our students. We want all students to have a successful, fulfilling experience at Gunma University. We are responsible for providing services and opportunities for our students that will enhance their experiences here at Gunma University and support their efforts to engage in academic studies.

Services offered
・ Comprehensive consultation
・ Student activities
・ Tuition fee exemption
・ Scholarships
・ Tutorial system
・ Career exploration and preparation
・ University housing (International House)
・ Immigration matters: Certificate of Eligibility / Extension of period / Part-time job permission
・ Off-campus resources: Rental bicycles / Part-time jobs / Housing comprehensive security
・ Healthcare

| Service Hours | Monday - Friday (except holidays) 8:30 am to 5:00 pm |
|---|---|

# A safe location where industry is growing

# Superb seasonal changes and activities
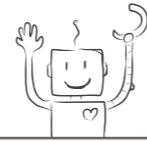
**Point 1**

## Location

Gunma prefecture is located inland, away from the threat of tsunami. The prefecture has a low risk of disaster, offering a high level of safety.

Gunma is situated in the center of the Japanese archipelago, 100 km northwest of Tokyo. The journey takes about 90 minutes by train.

Gunma

Tokyo

**90**min by **Train**

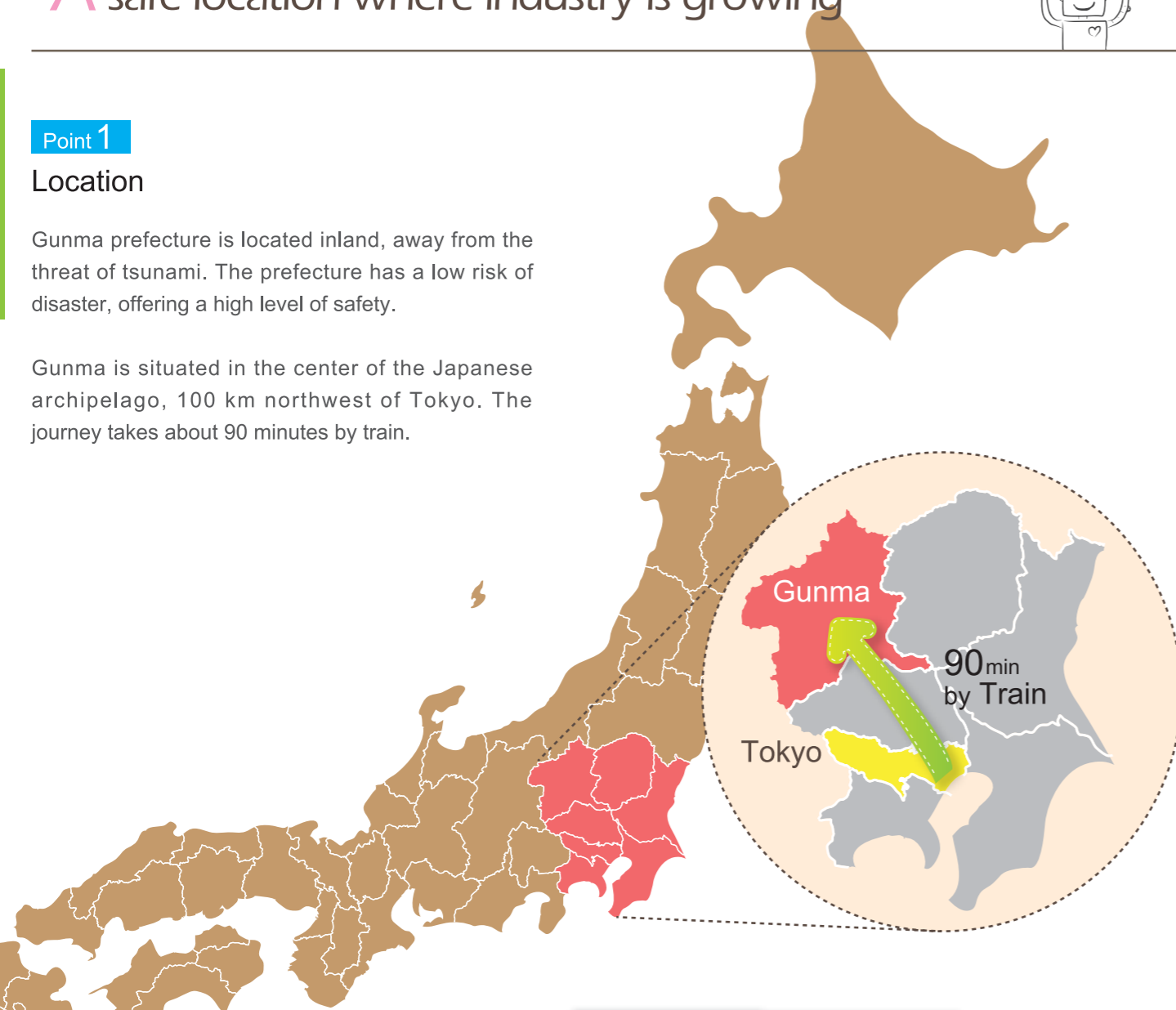Photo courtesy of Tomioka Silk Mill

**Point 2**

## A leader in industry and innovation

Gunma Prefecture has a long history as a technology and innovation leader in Japan, starting with the Tomioka Silk Mill, which was established by the Japanese government in 1872 as Japan's first model silk-reeling factory. At the end of its Edo period in the mid-19th century, Japan opened its doors to the world, ending a long period of seclusion, and in 1859 began to trade with Western countries.

**Point 3**

## Full utilization of advanced technologies

Many well-known carmakers have production sites in Gunma, which has a widespread manufacturing sector. A number of other production plants also take advantage of the advanced technologies available in Gunma Prefecture.
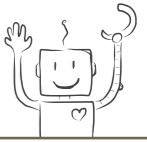
Spring — Oze

Summer — Fukiware falls

Autumn — Watarase Keikoku Railway

Winter — Ski resort

Gunma is a tourist destination full of charming hot springs, natural beauty and culture. It is gaining popularity as a convenient travel destination from the Tokyo Metropolitan Area.

Photo courtesy of visual Gunma

**Check!** Useful search keywords for discovering the attractions of Gunma   Search

Gunma Prefecture, "Gunmachan", Kusatsu, Himokawa, Daruma, Yaki-manjyu, Kita-Karuizawa, Ikaho, Akagi Myougi, Harunako, Sauce-Katsu, Karakkaze, Asama, Shima-Onsen, Minakami, Sauce-Yakisoba

# Gunma University Medical Innovation

## Gunma University

Pharmacy Instruments

Technology Material

New Global Engineer

Internship

Collaboration

Request/Proposal

Industries

### Gunma University Medical Innovation Project

Graduate School of Science and Technology

Graduate School of Medicine
Guraduate School of Health Sciences
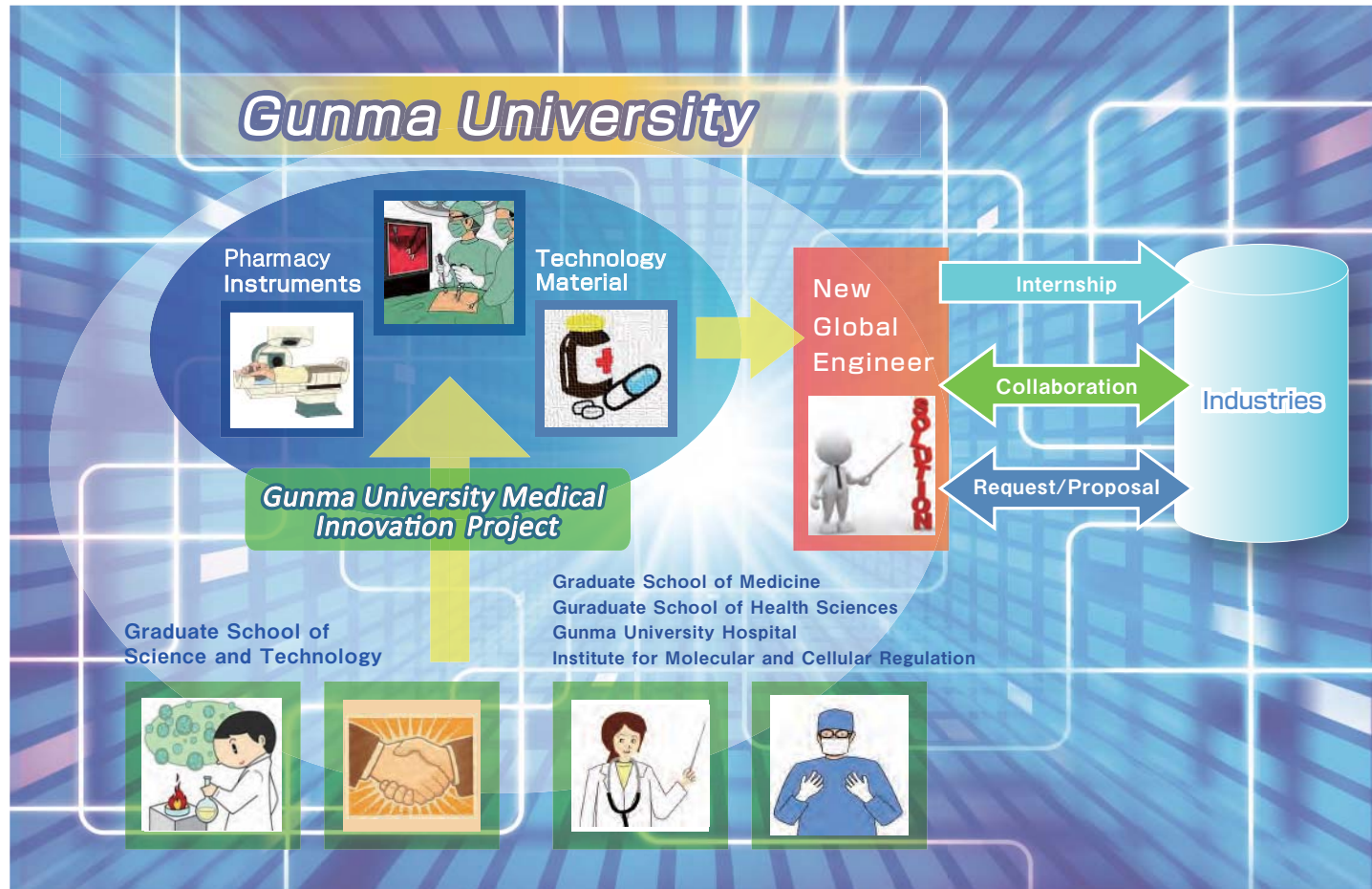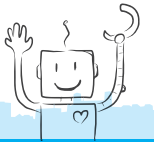Gunma University Hospital
Institute for Molecular and Cellular Regulation

### Point 1 Gunma University Medical Innovation Project

"Gunma University Medical Innovation Project" is a multi-disciplinary five-year research project started in 2014 with financial support from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

A number of researchers belonging to different organizations in Gunma University, such as the Graduate School of Science and Technology, the Graduate School of Medicine, and the University Hospital, are participating in the project. The main goals of the project are to develop new medical instruments, health monitoring devices, diagnostic and cure medicines, and so on, through tight collaboration among professionals from a variety of fields. Another important mission of the project is to educate young students to be a new type of global engineer who has professional engineering skills as well as an ability to create new prospects comprehensively in the field of medical engineering from a wide variety of knowledge.

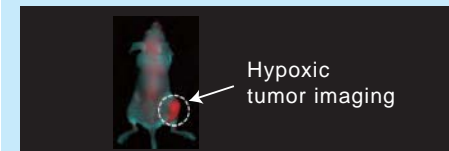## Micro-dosimeter for heavy ion dose monitoring

Check it !

Accurate dose distribution monitoring is a critical issue for the quality control of radiation cancer treatment. Therefore, there is a need to develop dosimetry at the micrometer scale (micro-dosimetry) with high special resolution and radiation sensitivity.
In this study we have successfully controlled the shape of a radio-photoluminescence (RPL) glass dosimeter with different types of activators for ionized particle detection. An RPL response around 500 - 600 nm was obtained under different radiation exposures. Moreover, dose distribution imaging was successfully visualized with a fabricated RPL glass dosimeter irradiated with a focused proton microbeam. The typical spatial resolution recorded was better than 10 $\mu m^2$.
We were also the first to succeed in fabricating glass elements with micrometer-size. These R&D achievements will enable us to obtain three dimensional dose distribution with quite a convenient procedure.

Radiat on Effect

200 μm

Bulk RPL dosimeter

Visualization of radiation spot in micrometer scale
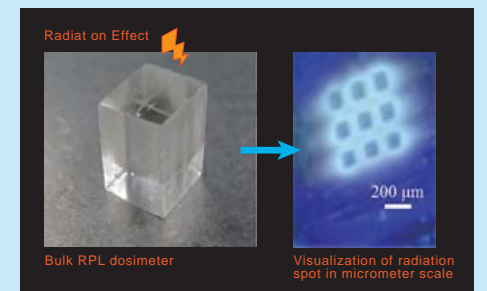
## Luminescent probes for *in vivo* oxygen imaging

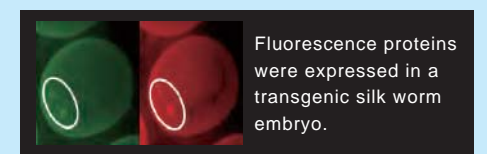Check it !

Hypoxic tumor imaging

The oxygen level of the interior of living cells and tissues is one of the central parameters in many physiological, pathological, and therapeutic processes. Oxygen deprivation (hypoxia) is connected with various diseases such as cerebral infarction and ischemic heart disease, and is known to occur in tumor microenvironments. We are developing optical probes to visualize the oxygen level of biological cells and tissues on the basis of photochemistry and chemical biology.

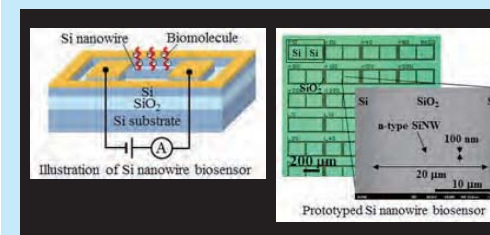## Identification and production of biologically active compounds

Check it !

Screening and design of novel drugs is one of our most exciting efforts to support drug development. We have established *in vivo, in vitro,* and *in silico* drug characterization systems and successfully identified new drug candidates, such as analgesics and antidiabetic drugs. We are also trying to express cancer vaccines using transgenic silkworms. The purified vaccines were shown to activate human T-cells and hold potential for cancer immunotherapy.

Fluorescence proteins were expressed in a transgenic silk worm embryo.

## Silicon nanowire based high-sensitivity biosensor

Check it !

Si nanowire  Biomolecule

Si
SiO₂
Si substrate

Illustration of Si nanowire biosensor

Si Si
SiO₂  SiO₂
n-type SiNW  100 nm
200 μm  20 μm  10 μm

Prototyped Si nanowire biosensor

A portable sensor with high sensitivity is needed for the detection of chemical or biological molecules in the fields of biotechnology and medical science. A silicon nanowire (SiNW)-based field effect transistor device has the potential to detect small quantities of biomolecules.
To realize high sensitivity for negatively charged biomolecules such as antigens, antibodies, and DNA, it is effective to use an n-type SiNW and to reduce the wire width. In this project, we fabricated an n-type SiNW using electron beam lithography, and evaluated its sensitivity for biomolecule detection. Currently, we have succeeded in fabricating an n-type SiNW with 100 nm width and detecting IgG antibodies with the extremely low concentration of fM($10^{-15}$ mol/L).

## Intuitive hands free interface

Check it !

Facial orientation is one form of body language that can be used to ask someone to move something. It is enough to indicate the intention by upward, downward, right, and left facing actions. Here, we applied these intuitive actions for auto-wheelchair operations. We focused on the change nostril shape to recognize the facial orientation on the grounds that it can be regarded as a more stable shape than any other facial feature points. In addition, the gazing action was also inputted to a computer to operate a communication-aid for input characters. The eyelid shape was approximated by the Bezier curve and its curvature was reflected on input operation.

Auto-wheelchair
Image processing
Gazing actions
Face directions

# Topics 02 — International Research and Education Center for Element Science
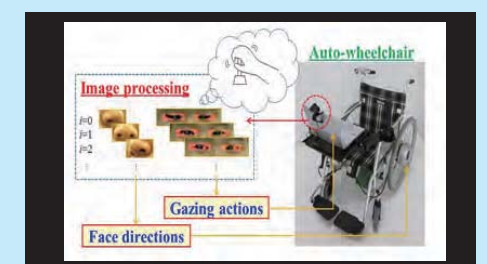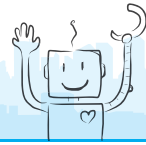
## About the Center

The International Research and Education Center for Element Science was founded in April 2015, based on the Element Innovation Project team. The faculty of Science and Technology at Gunma University has a long history of materials innovation based on carbon and silicon. The newly founded center mainly investigates advanced carbon materials and high-quality silicon compounds for use in dye-sensitized solar cells, non-precious catalysts for use in fuel cells, electrochemical double layer capacitors, and new active materials for lithium ion batteries and other applications. It also covers the areas of graphene physics and chemistry, as well as plasma chemistry to produce novel functional materials. The center has three faculty members and other members from other departments of the faculty. The laboratories of the center are well equipped with the latest instruments for nano-material science.

### Fascinating carbon materials

Have you ever heard of "carbon materials"? You can find the materials around you in your everyday life: pencil lead, bikes, rackets, refrigerator deodorizers, and so forth. I have been fascinated by this material for over thirty years because of its versatile properties, which can be tuned easily by preparation. Can you imagine ten-orders of magnitude changes? You can see such a big change when you carbonize organic molecules and measure their electrical conductivity. I was so excited by this fact when I was a masters student. Now my colleagues and I are interested in carbon catalysts that will replace precious metal catalysts, for example in fuel cells and chemical syntheses.

**Professor**
Jun-ichi Ozaki

### Nanoscale exploration of graphene and silicon surfaces

Our research is focused on understanding the fundamentals of molecule-surface interaction and properties of the resulting interfaces, leading to the development of an entirely new class of materials and sub-nanometer structures on surfaces. While silicon is the cornerstone of modern semiconductor technology, carbon materials such as graphene have emerged as the most promising materials for next-generation technology. We are investigating two technologically important materials: (1) graphene and (2) silicon surfaces. Our fundamental study will develop basic principles that will guide us in exploiting the findings in numerous socially pervasive applications, such as information technology, biotechnology, and renewable energy.

**Associate Professor**
Zakir Md. Hossain

### Surface chemistry of nano carbonsurface

Nano carbons, such as carbon nanotubes, fullerenes, and graphenes, are expected as high-performance electrode materials used in sensors and batteries due to their high surface areas, chemical stability, and electric conductivity. It is well known that the surface state of nano carbons strongly affects their performance as does the structural morphology at the nano scale. Thus analyzing and designing the surface and morphology are important issues for enhancing performance. My research subject is to develop useful techniques for preparing nano carbon materials

**Assistant Professor**
Takafumi Ishii

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# Topics 03 — Low-Carbon

## Aiming to Realize a Low-Carbon Society by Using Carbon Materials!

### Aiming for a Hydrogen Energy-Based Society

Although we need to minimize the load we place on the environment, we must also maintain our quality of the life. This presents a significant challenge. To make this possible, society needs to derive clean energy from hydrogen, and it is therefore desirable to build a hydrogen energy-based society. In order to achieve this goal, we need to establish an efficient system to produce hydrogen gas with carbon and store it for use as an energy source.

The fuel cell is a central part of the technology for using hydrogen. It is a power generation system that uses oxygen and hydrogen, and differs from conventional disposable batteries and rechargeable batteries as well as secondary batteries such as the ones used in mobile phones and digital cameras. It is able to generate electricity almost permanently as long as we continue to supply its fuel, which is of course hydrogen.

### Replacing Platinum in Fuel Cells with Carbon—a Cheap and Abundant Resource

Although platinum is the most common and active catalyst for proton exchange membrane fuel cells (PEMFC) to produce electricity, it is an extremely rare and expensive metal that is usually found only in parts of South Africa and Russia. This has hindered the spread of fuel cells, mainly because of unstable prices due to limited reserves and lack of political stability in the regions it is found.

That is why we are now focusing our research on technology using the element carbon. Carbon enables a significant cost reduction without any concern for resource depletion or unstable prices. Carbon atoms are almost limitless in nature and are found in abundance all over the planet.

Gunma University has been researching carbon materials for 60 years. Carbon Alloy Catalysts are carbon based materials that have been developed at Gunma University after many years of research.

Carbon Alloy Catalysts can be prepared by carbonizing mixtures of metal compounds and polymers. They also display high activity for oxygen reduction reaction, which is the cathode reaction of a PEMFC. Therefore the Carbon Alloy Catalysts are now expected to replace platinum as catalysts. Joint research with a chemical company is already under way to make this technology practical.

## Topics 04 Disaster Prevention Research
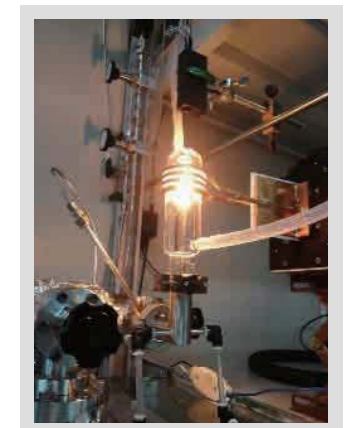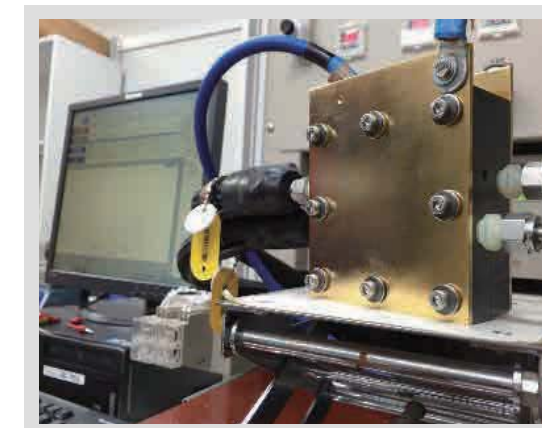
### Challenges for Construction of Social Technology for Achieving Zero Victims in a Disaster



The Research Center for Disaster in the Extended Tokyo Metropolitan Area was established to research mechanisms of natural disasters and methodologies for disaster prevention and mitigation, utilizing regional and geographical characteristics of Gunma Prefecture, which is located in the Extended Tokyo Metropolitan Area. The main research themes are as follows:

Risk management for a safe and secure society

Disaster prevention education

Improvement of disaster prevention in the geosphere and hydrosphere

Practice of disaster prevention strategies

On 11 March 2011, the tsunami that followed the Great East Earthquake caused massive widespread damage to the eastern coastal regions in Japan, claiming approximately 19,000 lives.

In the city of Kamaishi, which also suffered serious damage with more than 1,000 lives lost, Prof. Katada's research group had been conducting tsunami disaster prevention education in elementary and junior high schools for several years, which effectively saved many school-age children from this tsunami. The story of the successful evacuation due to disaster prevention education, keeping the number of victims among the students to almost zero, came to be known as "the miracle of Kamaishi."



#### Research1
**Effects of Lessons in Tsunami Survival and Actual Conditions during the Great East Japan Earthquake in Kamaishi**

The Tohoku District has suffered heavy damage by tsunami many times in the past, and there were lessons on how to survive tsunami based on residents' experiences. We examined the effect of these lessons during the Great East Japan Earthquake with the following focuses: 1) How many residents were able to evacuate from the tsunami according to past lessons? 2) Could residents who had evacuated according to the lessons survive the tsunami?
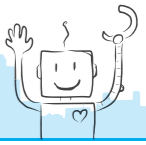
#### Research2
**Study on Risk Image of Floods and Its Effect on Evacuation Behavior**

When the water level of a river rises and evacuation is deemed necessary, the authorities issue an evacuation order. However, the evacuation rate of residents is said to be fairly low. Probably, residents think that a flood will not be dangerous, so they don't evacuate in spite of the hazardous situation. In this study, we carried out a questionnaire survey among residents of the city of Kiryu, which suffered heavy damage from flooding caused by Typhoon Kathleen in 1947, and we analyzed the actual status of residents' image of flood risk and its effect on their evacuation behavior.

#### Research3
**Effect Measurement of Landslides and Slope Failure Prevention Work by the Finite Element Method**

In order to achieve a reduction in landslide and slope failures, local governments should construct countermeasure structures in particularly high risk areas beforehand. We are developing a computer simulation methodology with an elasto-plastic constitutive model for measuring the effect of disaster prevention works.

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## Topics 05 The Gender Equality Promotion Activities

### The Mayudama Plan



In Gunma University, the Mayudama Plan, which has a project period of three years, was adopted in FY2013 as a Program to Support the Activities of Female Researchers (General) under the authority of the Ministry of Education, Culture, Sports, Science and Technology. The aim of the program is to realize a gender-equal society and support the major life events of female researchers, such as giving birth, raising children, and caring for family. Since then, various activities to promote the project have been vigorously carried out in each campus by the Gender Equality Office. The Gender Equality Office was established under the University President and plays a crucial role in the support of female researchers experiencing major life events by providing research support personnel, lifestyle support counseling, and various seminars that foster the advancement of research. These efforts have led to an increase in the ratio of female researchers, from 14.7% in FY2012 to 16.8% in FY2015.

Especially, in the School of Science and Technology, under the leadership of Dean Shinozuka, of the four new female researchers, one was also employed as a professor were employed in FY2014, doubling the ratio, which is regarded as a notable result. Also, activities in the School of Science and Technology, have included some unique events such as lunch meetings on special topics, a seminar to encourage female students to go to graduate school, and a special program for female high school students in the Open Campus event.



As a part of the Mayudama plan, Mayudama spaces have been opened in each campus in response to requests to provide a central location with easy access to a variety of information not only for female researchers but also all members of the university. Consulting services provided by senior researchers (mentors), a professional coordinator, and a work-life balance advisor are available there. The space also offers related books and data for public viewing. There is a crib too. Furthermore, Mayudama lunch meetings and Mayudama café events have been held regularly for faculty members and students. Kiryu Mayudama place is a relaxation room on the 5th floor of the Sougo-kenkyu building open from 1:00 p.m. to 4:00 p.m. Monday to Friday. Work-life balance advisor Harumi Nakamura is available for consultation from 10:00 a.m. to 4:00 p.m. on the 1st, 3rd and 5th Thursday of every month, and on one of these days, the Mayudama café is held from 11:30 a.m. to 1:00 p.m.

# A Human Resources Education System for Those Who Will Take Up the Baton of State-of-the-Art Technology, Backed by the Full Potential of the University
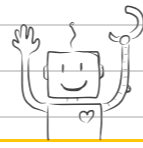
## Roots of Engineering Excellence

Although Gunma University was only established in 1949, the engineering, education and medical faculties that amalgamated to form the university date back to the beginning of the 20th century. The Faculty of Engineering's Kiryu location is a reflection of its roots as a school to educate the craftsmen needed for the textile industry that flourished in Kiryu at the time. The Kiryu School of Textiles was established in 1915. Later it expanded and the name was changed in 1920 to the Kiryu School of Technology. In 1944, the school became the Kiryu College of Technology on its promotion to college status. Finally, it joined with the medical and education colleges located in Maebashi to form Gunma University in 1949.

## Expansion & Renewal: The New Graduate School of Engineering

In 2013, the faculty instituted major reforms to meet the ever-changing demands of a modern technological society, and its seven existing departments were reorganized into four interdisciplinary departments. These departments offer students balanced educational programs of both basic science and advanced technology in interdisciplinary fields. Through this new system, we nurture engineers with a solid grounding in the natural sciences as well as a broad knowledge of modern technology.

| Doctoral Program | Master's Program |
|---|---|
| ■Materials and Bioscience | ■Materials and Bioscience |
| ■Mechanical Science and Technology | ■Mechanical Science and Technology |
| ■Environmental Engineering Science | ■Environmental Engineering Science |
| ■Electronics and Informatics, Mathematics and Physics | ■Electronics and Informatics, Mathematics and Physics |

Each department has a Cooperative Graduate School System or contributed laboratories that are responsible for managing the advanced educational activities and collaborative research carried out by staff specialists utilizing advanced technology in collaboration with other institutes and/or companies. Through these programs, our research activities as a Center of Excellence (COE) continue to advance to higher levels.



## Increased Educational Opportunities

Entrance examinations for the Graduate School of Science and Technology are held three times a year. The administrative examination is offered in the beginning of July, the summer examination at the end of August, and the winter examination at the end of December. In addition, special examinations are available for working students and international students. In order to help you achieve your dreams, we have prepared many programs, facilities and systems for education, campus life and the graduate school community. Furthermore, our programs also allow students to obtain a doctoral diploma if they have graduated from a university, a college of technology, or other institution of higher learning without a master's diploma. These openings are for those individuals who have been recognized as possessing advanced knowledge, research achievements, and/or other special abilities. The Graduate School of Science and Technology aims to carry out to research and develop advanced science and technology as a world-leading university. We look forward to seeing you on the Kiryu and Ota campuses.

## Organization Chart

School of Science and Technology
- Chemistry and Chemical Biology
- Mechanical Science and Technology
- Environmental Engineering Science
- Electronics and Informatics
- Integrated Science and Technology
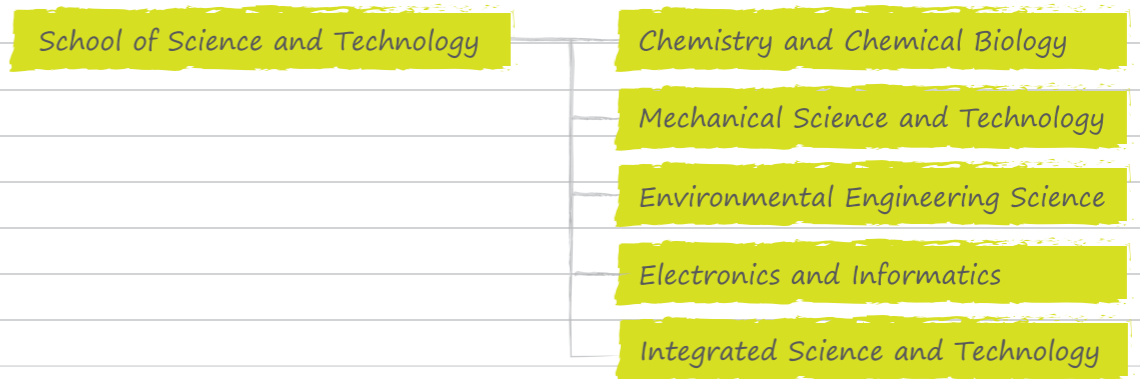
## Campus Photo

# Education Program of Materials and Bioscience Domain of Materials and Bioscience

*Department of Chemistry and Chemical Biology*

## Materials and Bioscience

In order to confront the complicated problems that contemporary society faces, the integration of science and technology in harmony with a broad range of fields has become increasingly important. The disciplines of chemistry and biology have contributed in this endeavor and it is certain that synergy between these branches of science will produce further breakthroughs by combining their common perspectives of "molecular transformation" and "functional organization of interactions."

To promote these developments, a new department was established in 2007 that fused chemistry and chemical biology, which has grown into the Division of Molecular Science. We are home to more than 30 research groups in major research areas of Molecular Science, Material Science and Chemical Biology. Each research group pursues its own research mission as well as collaborating on joint research projects with other groups.

## Faculty Members and Fields of Specialization ▶▶▶

| Faculty Members | | Fields of Specialization |
|---|---|---|
| Professors | Motoko S. Asano | Photophysics and design of photofunctional composite molecular systems including coordination compounds |
| | Hideki Amii | Development of synthetic organic reactions and their applications |
| | Keiji Ueno | Syntheses, structures, and reactivities of organo- and inorganometallic complexes |
| | Hiroki Uehara | Development of property and functionality of nano-structured polymeric materials |
| | Masafumi Unno | Organosilicon and organic heteroatom chemistry: molecular design, synthesis, and application |
| | Kenji Oosawa | Structural and functional analyses of bacterial flagella and chemotaxis receptors, and genome informatics |
| | Tetsuo Okutsu | Physical chemistry, photochemistry and crystal growth |
| | Hiroaki Ozaki | Structural analysis of nucleic acids by fluorescence. Synthesis and properties of modified nucleic acids |
| | Ken-ichi Kasuya | Structure and function of polyester-degrading enzymes, screening of microorganisms involved in the environmental cleanup |
| | Soichiro Kyushin | Structures and properties of organosilicon compounds |
| | Toru Kyomen | Solid state chemistry and design of functional oxides |
| | Takako Kudo | Molecular orbital study of silicon or transition metal compounds |
| | Kazuo Shinozuka | Chemistry of functional oligonucleotides such as antisense DNA, nonradioisotope labeled oligonucleotide probes, and the artificial nuclease system |
| | Soshi Shiraishi | Development of carbon-based nanoporous materials and electrochemical capacitors |
| | Yoshihiro Sumiyoshi | Studies on molecular structures of transient species and complexes consisting of radic |
| | Masashi Sonoyama | Biomolecular science, Biophysical chemistry of proteins, Biospectroscopy, Bioinformatics |
| | Hiroshi Takahashi | Structural analysis and thermal study of model biomembranes |
| | Shigeki Takeda | Functional analysis of receptors, characterization and application of protein self-assembly |
| | Kin-ichi Tsunoda | Opto-chemical sensors, liquid chromatography of metal chelates and atomic spectrometry |
| | Toshiaki Dobashi | Phase equilibrium of multicomponent solutions, structure of microcapsules and physical chemistry of biological materials |
| | Seiji Tobita | Photochemical and photophysical processes of aromatic compounds |
| | Yosuke Nakamura | Construction and properties of novel $\pi$-conjugated systems including fullerene chemistry and supramolecular chemistry |
| | Minoru Hanaya | Development and characterization of functional solid-state materials |
| | Mitsuhiro Hirai | Study of nano-structure, dynamics and functions of proteins/membrane signaling systems using neutrons and synchrotron X-ray |
| | Ichiro Matsuo | Glycoscience, Glycotechnology, Synthetic study of glycoconjugates |
| | Takeshi Yamanobe | Structure of polymers and solid state NMR |
| | Takao Yamamoto | Statistical physics |
| | Kaori Wakamatsu | Structural biology of proteins involved in signal transduction, prevention of protein aggregation, and development of epileptic rat |
| Associate Professors | Naoki Asakawa | Bio-inspired devices using emergent property found in polymers |
| | Yusuke Inoue | Functional analysis of the liver-enriched nuclear receptors using gene-targeted mice |
| | Shinji Iwamoto | Solvothermal synthesis of inorganic materials and their performance as catalysts |
| | Atsushi Enomoto | Suppression of antibody and T cell responses against allergens and autoantigens, advanced functional foods for prevention of diseases |
| | Md. Zakir Hossain | Chemical modification of epitaxial graphene on SiC substrate |
| | Hiroyuki Oku | Malaria vaccine and diagnosis material; biofunctional chemistry; biomedical and functional polymers |
| | Ken-ichiro Kanno | Synthesis and properties of novel organosilicon compounds using transition-metal complexes |
| | Masayasu Kuwahara | Creations of new nanobiomaterials based on functionalized nucleic acids |
| | Kiichi Sato | Development of micro bioanalysis systems |
| | Hiroshi Sano | Exploration of new synthetic methods based on organometallic chemistry, particularly for asymmetric synthesis and natural product synthesis |
| | Tsuyoshi Takahashi | Construction and application of functional molecules using peptide and protein engineering |
| | Nobuhiro Takeda | Synthesis of metal complexes bearing new ligands for the purpose of activating small molecules |
| | Hiroyuki Takeno | Self-assembling structure and dynamics of multicomponent polymer systems |
| | Yoshiharu Toyama | organisms and biomaterials |
| | Nobukazu Nameki | Analyses of novel translation regulation mechanisms, and structural bioinformatics |
| | Jun-ichi Fujisawa | Studies of organic-inorganic hybrid materials for light energy conversions |
| | Hiroaki Horiuchi | Study of photofunctional materials based on photo-physical chemistry |
| | Takako Muraoka | Studies on unique ligands with heavier typical elements and their transition metal complexes |
| | Tomohisa Moriguchi | Development of functional oligonucleotides, chemistry of natural products |
| | Minoru Yamaji | Photophysics and photochemistry of organic and organometallic compounds |
| | Keiichi Yamada | Development of novel bioactive peptides utilizing molecular imaging technique |
| | Toshitada Yoshihara | Photophysical and photochemical studies of aromatic compounds and its application for bioimaging |
| | Masaru Yoneyama | Transition metal-catalyzed polymerization, polymerization in specific environments, and synthesis of polymers with specific structures |
| Visiting Professors | Masayuki Ikeno | Development of silicone elastomers |
| | Maki Ito | Synthesis and structure analysis of silsesquioxanes |
| | Takahumi Imai | Polyorganosiloxanes: preparation, characteristics and industrial applications |
| | Takayuki Kawashima | Creation of new functional molecules utilizing main group elements |
| | Takeshi Saito | Preparation and evaluation of organic standard reference materials |
| | Noriaki Seko | R&D of the polymer modification technique by radiation processing |
| | Mitumasa Taguchi | Reactions of radiation-induced reactive species and their applications in water environment conservation |
| | Masahiko Numata | Preparation and evaluation of organic standard reference materials |
| | Yasunari Maekawa | Synthesis of thermally stable polymeric functional materials |
| | Atsushi Miwa | Research of the activity enhancement and DDS of oligonucleotide drug |
| | Tetsuya Yamaki | Nanotechnology Research and Material Development for Applications to Next-Generation Energy Devices |
| Visiting Associate Professors | Yoshinobu Konno | Process development of biopharmaceuticals |
| | Masaki Sugimoto | Synthesis of functional SiC ceramics from Si-based precursor polymers |
| | Ryoji Tanaka | Exploration of new synthesis methods in organosilicon chemistry |
| | Eiichi Tabei | Decomposition mechanisms of organosilicon compounds |
| | Naoko Nonose | Chemical standards for inorganic materials and plasma spectrometry |
| | Akihiro Hiroki | Radiation modification technologies for environment-friendly polymer materials |
| | Shigehiro Yanagihara | Development of test method and quality control of biopharmaceuticals |

### New functional bio-based plastics and clarifying the biodegradation mechanism of plastics

en-ichi asuya leads the Green Polymer research group at Gunma University. Research in his group focuses on the development of new functional bio-based plastics and clarifying the biodegradation mechanism of plastics. Recently his group has succeeded in synthesizing a fully bio-based plastic from a plant. In addition, he has been addressing the development of novel biodegradable plastics in order to solve profound problems caused by microplastics in the ocean.

**Professor Ken-ichi Kasuya**

### Toward understanding the biological function of carbohydrate through chemical synthesis

The main research focus in Professor Matsuo s laboratory is carbohydrate chemistry. Carbohydrates play various biological roles such as cell-cell recognition, differentiation, malignant transformation, bacterial infection, and glycoprotein quality control. Our research group is working on synthesis of glycoconjugates (e.g. N-linked and O-linked glycoprotein glycans, glycolipids, and glycosylated natural products) and chemically modified glycans, with the aim of clarifying the biological roles of carbohydrates, developing diagnosis systems for carbohydrate-related disorders, performing functional analysis of glycosyltransferases glycosidases, and developing glycosylated new materials.

**Professor Ichiro Matsuo**

### Students Voice

Graduate Student / Chowdhury Jakir Ahmed

**Professor Shinozuka's Laboratory, Gunma University Faculty of Engineering**

At Professor Shinozuka s aboratory, I was plunged straight into advanced research in oligonucleotide chemistry. I am thoroughly enjoying my time here at the university and have come to love not only the university, but also the local people here in Gunma. The local environment here is also extremely beautiful.

# Education Program of Mechanical Science and Technology Domain of Mechanical Science and Technology

## Department of Mechanical Science and Technology

## Faculty Members and Fields of Specialization ▶▶▶

| Faculty Members | Fields of Specialization |
|---|---|
| **Professors** | |
| Kenji Amagai | Thermo-fluid engineering, Interfacial flow, Atomization, Environmental fluid engineering |
| Tsuneaki Ishima | The experimental elucidation for flow, heat and mass transfer and laser application for flow including small particle |
| Shugang Wei | High-speed arithmetic circuits, VLSI systems, and digital audio signal processing |
| Seiichi Shiga | Mixture formation and combustion in internal combustion engines, liquid atomization |
| Ikuo Shohji | Heterophase interface science, micro joining, electronics packaging materials,brazing, surface treatment and corrosion of metals |
| Yusaku Fujii | Precision measurement, Optical measurement, Electrical-mechanical measurement |
| Tomohiko Furuhata | Combustion, spray flow and gas turbines |
| Masaaki Matsubara | Strength evaluation of new material and structural integrity estimation using fracture mechanics |
| Takao Yamaguchi | Numerical analysis for dynamics of cars etc., wave dynamics, vibration damping, sound proof |
| Ko Yamada | System control theory and its application, control of machine and robot, and intelligent control of the machine |
| Weimin Lin | Developing a high efficiency ultra-precision polishing machine. Reseach for the application of ELID process. Creating a desktop processing machine and test. |
| **Associate Professors** | |
| Tomoyasu Aihara | Microscopic evaluation of metal strength and destruction, and character of fluid bysimulation |
| Mikiya Araki | Jet engines, Jet noise, Combustion, Spray |
| Yoshinori Ando | Robust control theory and its application to the machine motion control and safety of the man-machine system |
| Atsushi Iwasaki | Structural health monitoring and composite material |
| Kazuomi Kusumoto | The electrode phenomena on welding and surface modification by PVD |
| Shinji Koyama | Precision bonding, surface hardening, corrosion resistance, wear resistance |
| Yoichi Shiraishi | Design automation algorithms, combinatorial optimization algorithms, |
| Takaaki Suzuki | Micro-Nano Systems and Control, Bio-applications |
| Nobuaki Nakazawa | Human interface, biomedical motion control, and motion planning for a robot |
| Yoshihiko Hangai | Fabrication and mechanical evaluation of porous metals |
| Masato Funatsu | Hypersonic and high-temperature gas dynamics, Thermal protection system for space vehicle, Plasma diagnoses by spectroscopy |
| Toshikazu Matsui | Human robotics (human mimetic control, human vision, and cooperative control of vision and body in humans) |
| Tsutomu Matsuura | Mathematical engineering, multivariate analysis, inverse problem, neural network, reproducing kernel theory |
| Shinichi Maruyama | Vibration analysis and measurements of machines and structures, Nonlinear phenomenon |
| Iwanori Murakami | Applied electromagnetics, Actuator, Applied of superconducting levitation, Jumping robot |
| **Visiting Professors** | |
| Makoto Kaneko | Thermohydrodynamic measurement and simulation |
| Shuji Matsumura | Numerical simulation of linear and nonlinear vibration noise and its application to the automobile |

## Mechanical Science and Technology

The university's Division of Mechanical Science and Technology has four fields for education and research: 1) intelligent systems, which covers the theories of control of mechanical systems, 2) energy systems, which includes aerospace and aeronautical propulsion, multiphase fluid dynamics, and combustion in internal combustion engines, 3) materials systems, where we explore new materials such as lead-free solder and perforated metals, and 4) mechatronics, which studies the mechanical dynamics of non-linear vibration, noise harshness, and the application of image processing to mechanical systems.

The division has received the JABEE accreditation for undergraduate education since 2003. The undergraduate program has nine educational objectives: to educate students in engineering ethics, to cover the fundamentals of social, cultural and natural science, to provide education in the four major mechanical engineering fields listed above, to nurture creativity through problem-based learning and research, to equip students with presentation and communication skills enable them to work with people all over the world, and to provide enough opportunity of team-working.

Frame structure

Constraint layer to absorbing effects

βSn

β-Sn

20 μ
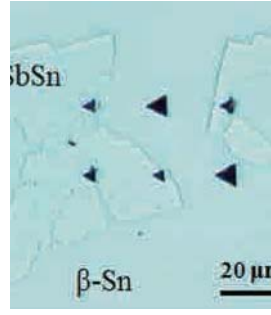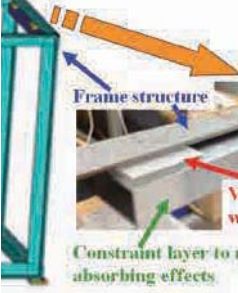
### New Arithmetic Circuits and Signal Processing

Computing systems are playing important roles in our daily lives. SI chips implementing controlling and computing units are used for real-time processing operations. A cell phone, for example, has high performance not only for communication, but also for viewing video and photo operations. In our laboratory, we are trying to find new SI algorithms to implement high-speed computing and controlling systems. Specifically, we present new methods for arithmetic operations using efficient number systems. We also aim to develop and design SI chips for self-driving vehicles.

**Professor    hu an    ei**

### Application of Fluid Mechanics, Cleaning of Semiconductor Wafers, Visualization and Measurement of Flow Behaviors

Fluid mechanics is a fundamental research field in mechanical science and technology with a wide range of applications, including the aircraft technology, car engineering, cleaning of electronics devices, and control of air pollution. Our laboratory studies a wide range of problems concerned with the cleaning process of semiconductor wafers based on experimental and modeling methods of fluid mechanics. We have also developed quantitative visualization and measurement techniques for fluid flows and some chemical substances. As application themes of fluid mechanics, we also study micro-bubble flow and liquid atomization phenomena.

**Professor Ken i    a ai**

(a)
(b)
(c)
(d)

Fig. A mathematical technique called Independent Component Analysis (ICA) can restore original signals from the mixed signals.

(a) Four mixed images that have different mixed ratios of four original images (hand, cat, zebra and noise).
(b) Four restored images computed by ICA (20 iterations).
(c) Four restored images computed by ICA (50 iterations).
(d) Four restored images computed by ICA (3000 iterations), which are almost the same as the original images.

External ramp

Fig. Beyond the sonic barrier: supersonic jet from a test nozzle, (top) turbulence structure, and (bottom) operation of a hydrogen afterburner. (Prof. Mikiya Araki)

## Students Voice

Graduate Student / Hefeng Liang

### My experience in Gunma University

In 2011, I came to Gunma University as an exchange student. In a totally new environment, I expanded my horizons and enriched my experience. Now I am studying in the Department of Mechanical Science and Technology. Under the patient guidance of my professor, my expertise has been further improved. Meanwhile, I have met some Japanese friends in my extra-curricular activities, which has helped me understand Japanese culture more deeply.

# Education Program of Environmental Engineering Science Domain of Environmental Engineering Science

*Department of Environmental Engineering Science*

## Faculty Members and Fields of Specialization ▶▶▶

| Faculty Members | Fields of Specialization |
|---|---|
| **Professors** | |
| Hideyuki Itabashi | Speciation of metal ions, complexing capacity of natural water samples, and solvent extraction of metal ions based on the HSAB principle |
| Takayuki Ohshima | Applications of pulsed electric field in biotechnology. Development of water treatment system with high-voltage devices. |
| Jun-ichi Ozaki | Design and preparation of catalytic carbon materials, particularly used in the applications of fuel cell and biomass conversion. |
| Toshitaka Katada | Disaster management for safe and secure society |
| Shinji Katsura | Development of manipulation technologies for biological molecules and their industry applications |
| Yutaka Kawahara | Biomass science, development of bio-based materials and utilization of natural fibrous resources |
| Shin-ichi Kuroda | Development of functional and high performance materials through the surface and interface control by means of plasma and photo-techniques |
| Yoshihiko Shimizu | Mechanics of sediment transport, fluvial process in stream with vegetation, and river management |
| Shin-ichi Tobishima | Study of new materials for advanced high energy batteries and new energy conversion technology |
| Nobuyoshi Nakagawa | Development of an efficient liquid fuel cell by means of catalyst preparation and by optimizing the electrode structure. |
| Akihiko Wakai | Numerical simulation of slope failure induced by earthquake |
| Tomohide Watanabe | Biological wastewater treatment, microbial and physicochemical degradation of water pollutants, Advanced water / wastewater treatment , resource recovery |
| **Associate Professors** | |
| Tsukasa Ito | Water treatment, environmental microbiology and biodegradation of environmental pollutants |
| Ken-ichi Uzaki | Three-dimensional structure of wind-driven currents accompanied with river including the coastal zone secondary circulations, regional sediment transport process in the Tone |
| Masahiko Oshige | Development of bio-molecular manipulation methods and application of reaction process analysis by using molecule design techniques |
| Mitsuo Ozawa | Fire resistance of concrete, Control of cracking due to volume change in concrete at early age |
| Masanobu Kanai | Risk communication, Community activity for disaster prevention,  Disaster education |
| Takahiro Saitoh | Applied mechanics, computational mechanics and non-destructive evaluation for civil engineering structures |
| Reiji Noda | Development and evaluation of waste/biomass energy utilization processes, Evaluation and design of a local society based on energy/mass flow analysis |
| Masaru Hakoda | Application of electrostatics on bio-separation and micro-chemical systems, development of bio-micro-electromechanical systems |
| Azuchi Harano | Reaction mechanisms of aerosols with air pollutants and development of a preservation technology of the environment |
| Masanobu Mori | Development of water purification systems and water-quality monitoring systems |
| Hideyuki Morimoto | Mechanochemical synthesis and electrochemical properties of battery materials |
| **Visiting Professors** | |
| Hiromi Shirai | Environmental combustion engineering, clean energy conversion engineering |
| Hisao Makino | Aerosol engineering, clean coal technology |
| **Visiting Associate Professor** | |
| Kenji Tanno | Numerical combustion simulation, Energy control |

## Environmental Engineering Science

Environmental challenges such as climate change, natural disasters, growth of energy consumption, shortage of natural resources, are affecting people both globally and locally. This situation is creating demand for human resources who can resolve these challenges. The university's Environmental Engineering Science program aims to educate engineers and researchers who can contribute to establish safe and sustainable society in harmony with the environment through collaboration between Chemical & Environmental Engineering and Civil & Environmental Engineering.

The program conducts academic activities from two aspects: 1) environmental/energy conservation and 2) infrastructure management/disaster prevention. From the environmental and energy perspectives, the program develops engineering knowledge and skills in environmental, energy, material, and biological fields for realizing a sustainable society based on chemical engineering. From the infrastructure and disaster prevention perspectives, the program develops human resources for planning, design, construction, and maintenance of safe and sustainable infrastructure and social systems.

### Students Voice

**Graduate Student   Sun Yan (China)**

**Education program of environmental engineering science, graduate school of science and technology**

aily life in my laboratory is very busy, because we must organize everything from research planning to design, construction and operation of experimental setups and summarization of experimental results.　ut, I like my laboratory life. That is because being busy also leads to my own growth. Whenever I failed and felt down, my supervisor and lab members always cheered me up. They also let me know　give someone a fish and you feed them for a day　teach someone to fish and you feed them for a lifetime .

### Numerical Simulation for Earthquake-Induced Landslides

Development of effective procedures to predict earthquake-induced landslides accompanying catastrophic slope failure is one of the important issues to be resolved in our ongoing efforts for improvement of disaster prevention. We have proposed a new elasto-plastic constitutive model to simulate strain-softening behaviors of sensitive soils under cyclic loading, which has been applied to the finite element simulation of a lot of past catastrophic landslides caused by each earthquake motion. We are trying to analyze the mechanism of catastrophic failure in detail with clarifying the relationships between the slope stability and the strain-softening characteristics of contained soils.

**Professor  Akihiko Wakai**

### Development of Steam/Hydrogenation Hybrid Process for High-Grade Oil Production from Biomass

Biomass resources such as agricultural wastes or animal mature are widely spread, causing high collection and transportation costs and hindering efforts to establish their large scale utilization. To utilize this biomass requires the development of small-scale plants with high economic efficiency. We are working to establish an economically efficient plant by developing a small-scale process for unutilized biomass, which produces high-grade oil and electricity matching with local demand.

**Associate Professor Reiji Noda**

$Gd_{0.2}Ce_{0.8}O_{1.9}$

NiO

100 nm

# Education Program of Electronics and Informatics, Mathematics and Physics
## Domain of Electronics and Informatics, Mathematics and Physics

*Department of Integrated Science and Technology*

## Electronics and Informatics, Mathematics and Physics

Division of Electronics and Informatics covers information and communication technology areas and it consists of two courses: electronics course and informatics course. Each course has three major areas.

(1) Electronics course is hardware and physics oriented. Our target is to contribute electronics, communication and computer as well as power electronics areas. We provide students education of fundamental and advanced electronics, electronic devices, semiconductor, electromagnetic wave theory, communication, power & energy electronics, control, measurement, computer hardware & software, circuits & systems and signal processing algorithm as well as their related research activities.

(2) Informatics course is software and mathematics oriented. Our target is to contribute computer software & hardware, multi-media, communication and network areas. We provide students education of fundamental and advanced electronics, electronic devices, semiconductor, electromagnetic wave, communication, power & energy electronics, control, measurement, computer hardware & software, circuit & systems and signal processing algorithm as well as their related research activities.

### Producing next generation media technology

Rapid progress of high-speed image processing and image projection technologies is increasing demand for, high-speed, adaptive image acquisition and projection . Our laboratory proposes a new media technology named Dynamic Image Control(DIC) that refers to a technical concept of dynamic and adaptive control of image acquisition and or projection depending on the scene. DIC requires optimization of all components of imaging and projection systems, including imagers, optics, and illumination. Thus, both devices and system application are studied in this laboratory. Envisaged application fields of DIC are image industries such as film and advertising, medicine and biology requiring microscopic measurement, factory automation, and human-machine interfaces requiring comprehensible images.

**Associate Professor Hiro Masatu**

### Measurement technologies visualizing invisible information

In medical diagnostics, various measurement technologies have been developed to look inside the human body non-invasively. One of the typical examples is X-ray CT. These technologies commonly utilize image reconstruction algorithms, which estimate indirectly the inner image of the object under measurement by using the data directly observed and enable visualization of internal information that we cannot directly observe. Similar measurement technologies are widely needed not only in medical diagnostics but also in industry for nondestructive inspection. New measurement technologies adapted for individual purposes and applications are expected. In our laboratory, we are developing measurement technologies of this kind, such as electrical impedance CT for healthcare, which visualizes body fat distribution in the body from impedance data observed on the body surface.

**Associate Professor Tadashi Ito**

## Faculty Members and Fields of Specialization ▶▶▶

| Faculty Members | | Fields of Specialization |
|---|---|---|
| **Professors** | Takeo Ishikawa | Electrical machines, power electronics, optimal design, and computer simulation |
| | Masahisa Ito | Magnetic structures and electronic properties of magnetic materials studied by magnetic diffraction, scattering and absorption of synchrotron radiation |
| | Haruo Kobayashi | Analog and digital integrated circuit design and signal processing algorithms |
| | Hiroshi Sakurai | Magnetic nano device, measurement using x-rays |
| | Hayato Sone | Nanometer measurement and fabrication, nanoelectronic devices, high-sensitive biosensor for medical use, crystal growth |
| | Kazumasa Takada | Design and characterization of optical fiber and WDM devices, Optical sensing |
| | Manabu Takahashi | Theoretical study on electronic properties and magnetism in transition metal compounds |
| | Seiji Hashimoto | Motion control, system identification, vibration control, precision control, renewable energy |
| | Osamu Hanaizumi | Devices for optical communication, Microphotonics |
| | Kuniyuki Motojima | Radio wave propagation, Wireless measurement, Electromagnetic wave simulation |
| | Yoshiki Yamakoshi | Ultrasonic imaging systems for medical diagnoses, and measurement using ultrasonic waves |
| **Associate Professors** | Tadashi Ito | Computed tomography and its applications, inverse problems in measurement |
| | Syun-ji Ozaki | The optical properties and electronic energy-band structures of nanoatructured semiconductors and ternary compound semiconductors |
| | Tamihiro Gotoh | Material science for optical devices |
| | Morihiko Sato | Production of pulsed power generation system with MOSFETs and underwater pulsed electric discharge |
| | Nobukazu Takai | CMOS analog integrated circuit design and its automated design algorithm. |
| | Toshiki Takahashi | Physics of compact torus plasmas for thermonuclear fusion reactors |
| | Yoshitaka Takahashi | Optoelectronics and quantum electronics |
| | Tatsuya Nagao | Theory of strongly correlated electron system |
| | Toshiya Hikihara | low-dimensional strongly correlated electron systems, quantum spin systems, numerical calculation |
| | Shin-ichi Furusawa | Physics of solid state ionics, nanoionics, ionic device. |
| | Akio Matsuoka | The production and electrical properties of Fullerenes |
| | Kenta Miura | Light-emitting materials and devices, Photoelectric devices |
| | Takashi Miwa | Applied measurement for electromagnetic and ultrasonic wave |
| | Yoshifumi Morita | Theoretical study on low dimensional quantum systems and superconductors |
| | Yasushi Yuminaka | Multiple-valued logic and new-paradigm analog/digital integrated circuits |
| **Information Science (sub-course)** | | |
| **Professors** | Kazuyuki Amano | Computational complexity, theory of algorithms, machine learnig |
| | Naoya Ohta | Image processing, computer vision, and pattern recognition |
| | Yoichi Seki | Data mining, statistical learning theory and applied data analysis |
| | Shin-ichi Nakano | Graph algorithm, and Information visualization |
| | Koichi Yamazaki | Combinatorial optimization, approximation and randomized algorithms, computational complexity |
| | Hidetoshi Yokoo | Data compression, data structures, and information theory |
| **Associate Professors** | Toru Araki | Graph theory, Graph algorithm, Combinatorial optimization |
| | Hiromasa Oku | Dynamic image control, High-speed image processing, High-speed optical devices |
| | Tsuyoshi Kato | Bioinformatics, machine learning, and statistical analysis |
| | Ken-ichi Kawanishi | Information and communication systems, performance evaluation, queueing theory |
| | Ken-etsu Fujita | Logic of programming, programming languages |
| | Ushio Yamamoto | Human interfaces, computer networks, and multi-agent systems |
| | Hirofumi Yokouchi | Logic of programs and its applications to programming languages |
| **Mathematical Science** | | |
| **Professors** | Masaaki Amou | Transcendental number theory, Diophantine approximations |
| | Kazumi Tanuma | Elasticity equations, inverse problems |
| | Shuji Watanabe | Integral transforms of Fourier type, commutation relations in quantum mechanics and their applications |
| **Associate Professors** | Kazuo Amano | Computer algebra, numerical analysis, differential equations |
| | Hirofumi Nagoshi | Analytic number theory, value-distribution of arithmetic functions |
| **Lecturer** | Takeshi Ohtsuka | Geometric surface evolution equation, Singular limit of reaction diffusion equation |
| | Toshimitsu Takaesu | Spectral Analysis and Scattering Theory for Relativistic Quantum Field Models |
| **Visiting Professors** | Koji Asami | Measuring and testing techniques for RF, analog and mixed-signal LSIs. |
| | Masahiro Ishida | Testing methodologies for LSI circuits |
| | Teruo Kohashi | Magnetic metrology, Spin polarized scanning electron microscopy |
| | Kazuo Saito | Advanced electronic engineering |
| | Naoya Sasaki | Molecule dynamic simulation, Nanometer dynamics of lubrication and wearing |
| | Takahiro Miki | Analog integrated circuit design |

### Students Voice

**Graduate Student Electronics and Computing Rivero Rachelle Alvarez**

My current research is about developing and applying machine learning techniques for data analysis. Data obtained nowadays are not only big, but also complex and unstructured thus extracting knowledge from such data has become a difficult task. One of my interests includes data fusion, in which different data types are integrated in an effort to improve the accuracy of data analysis. Finding patterns and structures from big, complex data is now of particular interest among computer scientists and mathematicians alike, and combining various data might lead us to new and exciting insights about data analysis.

# Procedures for Entering Japan
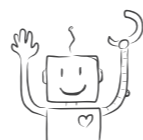
Students admitted to Gunma University as an "International Student (Ryugakusei)" should have a Certificate of Eligibility as a student. If a foreign student does not possess this status, services to international students, including scholarship applications, will not be available.

## Procedures for Entering Japan

All future international students need to hold a valid passport issued by their home countries and a corresponding Student Visa issued by the Japanese Embassy or Consulate. In order to receive a Student Visa, you must first obtain a Certificate of Admission from Gunma University and then a Certificate of Eligibility from the Tokyo Immigration Office. Once you decide to enter Gunma University, we recommend that you apply as soon as possible for a Certificate of Eligibility through Gunma University. It takes one to two months. Should you have any questions regarding the application procedures, please contact the supervisor.

### Flow Chart of Immigration and Admission Procedures

**Procedure**

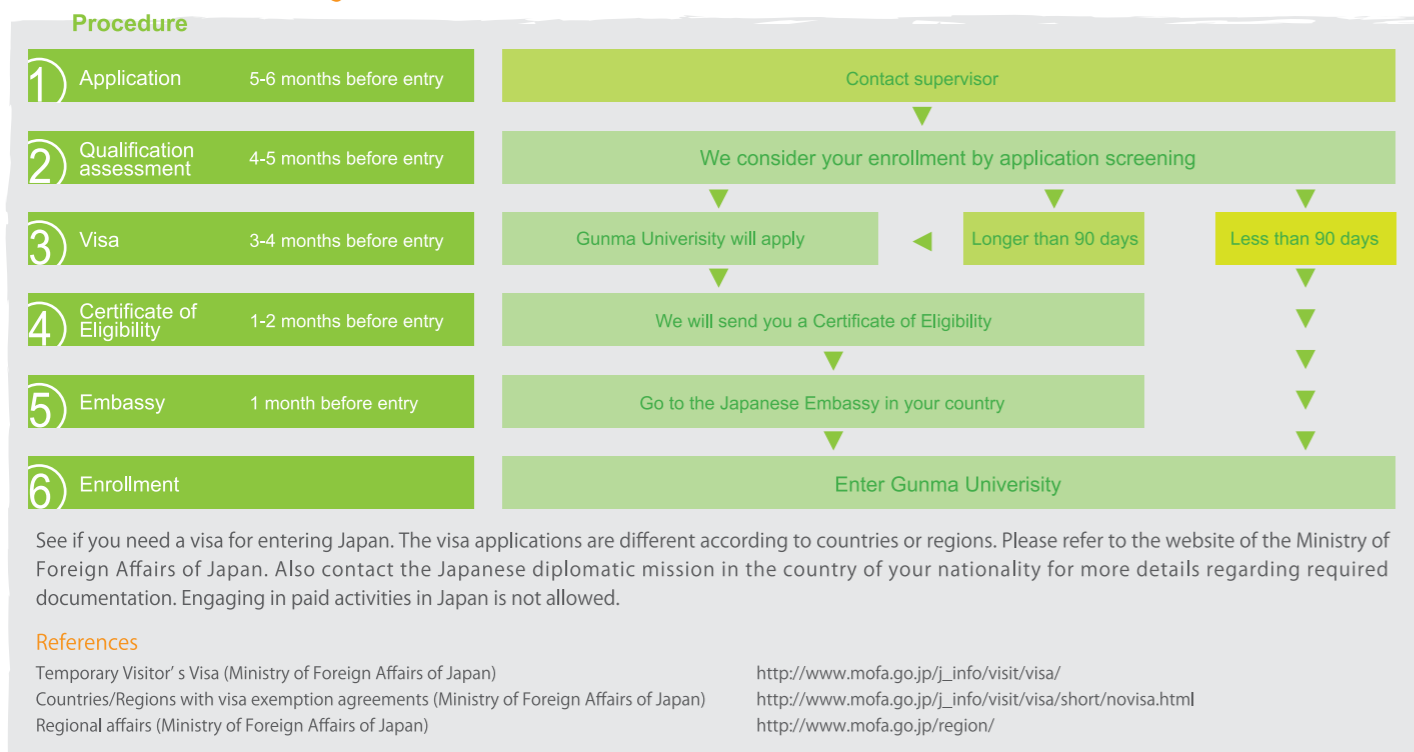| 1 | Application | 5-6 months before entry | Contact supervisor |
| 2 | Qualification assessment | 4-5 months before entry | We consider your enrollment by application screening |
| 3 | Visa | 3-4 months before entry | Gunma Univeristy will apply ◄ Longer than 90 days / Less than 90 days |
| 4 | Certificate of Eligibility | 1-2 months before entry | We will send you a Certificate of Eligibility |
| 5 | Embassy | 1 month before entry | Go to the Japanese Embassy in your country |
| 6 | Enrollment | | Enter Gunma Univeristy |

See if you need a visa for entering Japan. The visa applications are different according to countries or regions. Please refer to the website of the Ministry of Foreign Affairs of Japan. Also contact the Japanese diplomatic mission in the country of your nationality for more details regarding required documentation. Engaging in paid activities in Japan is not allowed.

**References**

Temporary Visitor's Visa (Ministry of Foreign Affairs of Japan)
http://www.mofa.go.jp/j_info/visit/visa/
Countries/Regions with visa exemption agreements (Ministry of Foreign Affairs of Japan)
http://www.mofa.go.jp/j_info/visit/visa/short/novisa.html
Regional affairs (Ministry of Foreign Affairs of Japan)
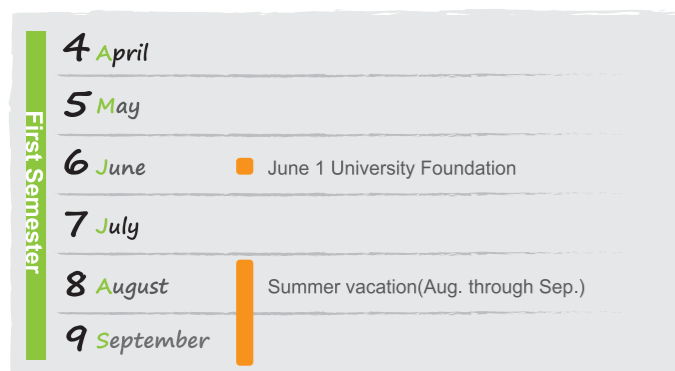http://www.mofa.go.jp/region/

## Procedures for Foreign Nationals Currently Residing in Japan

After completing the procedures for admission to Gunma University, you need to apply for a "Change of Residence Status" at the local immigration office. This is only necessary if your current status is not "Student." If you will be moving to or near the campus from another city or town, you should go to your new town or city office to apply for resident's registration and for a change in your National Health Insurance status.
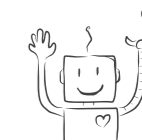
| After receiving letter of permission | Tokyo Immigration Office Apply for change/extension of resident status | City Office Apply for resident registration |
| --- | --- | --- |

### Academic Calendar

■ Holidays / Saturdays, Sundays and National holidays

**First Semester**

| 4 | April | |
| 5 | May | |
| 6 | June | ■ June 1 University Foundation |
| 7 | July | |
| 8 | August | Summer vacation(Aug. through Sep.) |
| 9 | September | |

**Second Semester**

| 10 | October | |
| 11 | November | |
| 12 | December | Winter vacation (late Dec. to early Jan.) |
| 1 | January | |
| 2 | February | Spring vacation (early Feb. to early Apr.) |
| 3 | March | |

# Student Life and Expenses

## Tuition and Fees

Studying in Japan inevitably requires a certain amount of financial resources as outlined below. The university requires students to confirm a sufficient preparation of funds before enrolling at Gunma University.

| | Entrance Examination Fee | Admission Fee | Tuition |
| --- | --- | --- | --- |
| Graduate Student | 30,000 yen | 282,000 yen | 535,800 yen (per annum) |
| Research student | 9,800 yen | 84,600 yen | 29,700 yen (per month) |

※ Additional charges such as a faculty membership fee and an insurance fee are required to paid.
■ If tuition is revised, the new tuition fee is applied from the time of the revision.

## Exemptions from Tuition Fees

Students enrolled in graduate and undergraduate courses are eligible for a 50 % or 100 % remission of fees if they are facing financial difficulties and are maintaining a record of excellent scholastic achievement, subject to their performance on a strict examination. The free tuition system applies to exchange students from sister schools based on inter-university exchange agreements.

## Living Conditions and Accommodation

### Private Housing
Rental apartment fees in Gunma are as follows: Private apartments and lodging houses (as of April, 2013)

| | Apartment Features | Rent per Month |
| --- | --- | --- |
| Apartment | Six tatami mats | 20,000 to 30,000 yen |
| | Kitchen | |
| | With lavatory, shower and bath | |

### Gunma University International House
The Gunma University International House is an international student residence facility located in Kiryu. Residency is limited to one year.

| | Room Fee | Number of Rooms |
| --- | --- | --- |
| International House | 5,900 yen Single | 33 |
| | 11,900 yen Couple | 2 |
| | 14,200 yen Family | 1 |

### Keishin Dormitory
The Keishin Dormitory is next to Gunma University International House

| | Facilities | Rent (Monthly) |
| --- | --- | --- |
| A Type | Private kitchen, toilet, shower, and bath | 25,000 yen |
| B Type | Shared kitchen, toilet, shower, and bath | 15,000 yen |

### Other Expenses
In addition, expenses for food (approx. 30,000 to 50,000 yen a month), textbooks and materials, as well as other miscellaneous costs should be taken into account.

### International Student Housing Comprehensive Security
Gunma University cooperates with the "International Student Housing Comprehensive Security" program. When international students are covered by this insurance program, Gunma University becomes the guarantor, and the student can then rent a private apartment by signing an occupancy contact. Under this scheme, if a fire caused by negligence occurs in an occupied housing unit of an international student and the student is forced to pay damage compensation to the owner of the apartment, or if the occupant falls into arrears on rental payments and the guarantor is requested to assume responsibility for paying these guaranteed liabilities to the owner, the guarantor can pay the compensation directly to the owner.

## Scholarship

The following scholarships are available for international students studying in Japan.

### JASSO Honors Scholarship
This scholarship is available to highly qualified international students studying in Japanese universities at their own expense. The monthly stipends are 65,000 yen for graduates and 48,000 yen for undergraduates. In 2013, 12 students from Gunma University qualified for this scholarship.

### Other Scholarships
Private organizations provide scholarships for highly qualified international students studying in Japanese universities at their own expense. The stipends range from 20,000 yen to 150,000 yen depending on the organization. In 2013, 17 students from Gunma University qualified for these scholarships.

### Japanese Government Scholarship
In 2013, the monthly stipends are 143,000 to 145,000 yen for postgraduate students and 117,000 yen for undergraduate students. For further details, please inquire at the Japanese Embassy in your country. As of June 2013, 31 students of Gunma University qualified for the scholarships.

## Tutorial system

International students often run into difficulties studying or conducting their research after they start their student life in Japan. Gunma University provides a tutorial system for those students. A tutor and an international student pair up and conduct regular activities. Tutors support their partner students in their studies and/or research. International students are encouraged to take advantage of this system, not only to assist them in their studies, but to increase their communication opportunities with many other students.

# Graduate School Entrance Examination

| 01 Contact supervisor | ➡ | 02 Qualification assessment (if required) | ➡ | 03 Application | ➡ | 04 Screening examination | ➡ | 05 Announment of results |
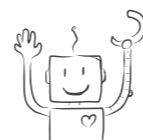
## 1.Contact supervisor

Send a letter stating your request for research guidance to the faculty member of your preference. You can find the appropriate address for the faculty member by contacting the office directly. To see to the focus research areas of each faculty member, please refer to the website.

## 2.Qualification assessment (if required)

We have established deadlines for confirming an applicant's qualifications (see the following table for details). You need to provide an Entrance Qualification Examination Application prior to the deadline for the course you wish to enter.

## 3.Application

Be sure to file your application in accordance with the established deadlines for your preferred course (see the following table for details). The following materials are required:
» Application for admission
» A certificate of your graduation from the last university you attended, as well as transcript
» A certificate of your nationality and / or residence status if currently residing in Japan
» An outline of your past research achievements and your intentions for future research activities
» Two photographs (4cm × 3cm)
» Testing fee (30,000 yen)
» Authorization document from the head of the department of your current academic institution or place of employment if applicable

## 4.Screening examination

The screening examinations are held at Kiryu campus on the scheduled day for examination for each course (see the following table for details).

## 5.Announcement of results

Successful applicants will receive an announcement in the mail on the scheduled day for announcing the results of the examinations for each course (see the following table for details). Examinee numbers will also be posted on the website.

## Table of Admission Procedures

| Program/Course | Distribution of essential points | Qualification assessment | Application | Screening examination | Examination categories | Announcement of results |
|---|---|---|---|---|---|---|
| MS (Oct.adm.) | Mid- Jun. | Early Jul. | Mid- Jul. | Late Aug. | *F, R, M, I | Early Sep. |
| PhD (Oct.adm.) | Mid- Jun. | Early Jul. | Mid- Jul. | Late Aug. | I | Early Sep. |
| MS (Summer) | Mid- Jun. | Early Jul. | Mid- Jul. | Late Aug. | *F, R, M, I | Early Sep. |
| PhD (Summer) | Mid- Jun. | Early Jul. | Mid- Jul. | Late Aug. | I | Early Sep. |
| MS (Winter) | Late Oct. | Mid- Nov. | Late Nov. | Late Dec. | *F, R, M, I | Mid- Jan. |
| PhD (Winter) | Late Oct. | Mid- Nov. | Late Nov. | Late Dec. | I | Mid- Jan. |

The content of the examination categories marked with an asterisk (*) varies depending upon the field of specialization. Be sure to confirm the content for your particular field of specialization in the application guidelines.

F: foreign language, M: major subjects, I: interview, S: short thesis, R: requires subjects

# Under Graduate School Entrance Examination
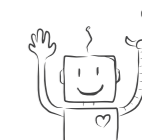
In order to enter a faculty as a regular student, you need to take the Examination for Japanese University Admission for International Students (EJU) held in June and November. Make sure you know which test subjects you are required to take for the faculty you have chosen.

Application packages with application forms will be distributed from October. Please have one sent to you by Gunma University.

Applications will be accepted from January. Entrance examinations will be held in February.

Detailed information on entrance examinations and other items is posted in the Information on entrance examinations & applications for Gunma University website.

» http://www.cier.gunma-u.ac.jp/english/page1/nyuushi.html
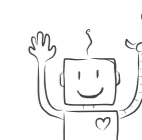
# Research Students

Gunma University has a system of for research students which allows applicants to study in specialized research fields after screening, provided that the university has enough capacity for education and research. With regard to the admissions application periods and the screening methods, and related matters, situations vary depending upon the course to which you wish to be admitted. The following table is meant to serve as a general outline. Be sure to confirm the details on the website of the particular faculty and course that you are considering. In order to proceed smoothly with regard to professional guidance in your preferred field of research after being admitted, you should determine your field of research and laboratory after you have established contact with a faculty member who deals with your preferred field of specialization.

The following materials are required:

» Application for admission
» A certificate of graduation from the last school you attended, as well as a transcript
» A certified copy of a certificate verifying your nationality and / or residence status if currently residing in Japan
» An outline of your past research achievements and your intentions for future research activities
» Two photographs (4cm× 3cm).
» Testing fee (9,800 yen)
» Authorization document confirming your status as a student or employee from the head of the department of your current academic institution or place of employment

| Qualification | Application | Screening Method | Announcement of the Result | Admission Period |
|---|---|---|---|---|
| Bachelor/Master's Degree | As applicable | Interview, document screening | As applicable | As applicable |

Q: How high is Gunma University ranked among universities in the world and in Japan?

A: According to the Times, an authoritative British magazine, Gunma University was highly evaluated in world rankings, at 252nd in 2006, 331st in 2007, 396th in 2008, 401st to 500th in 2009, 551st to 600th in 2010 and 401st to 500th in 2011., In Japan, the university was ranked 16th in 2006, 17th in 2007, 23rd in 2008, 20th to 33rd in 2009 and 21st in 2011.

# University Data
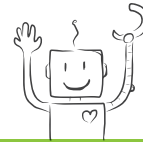
## Number of International Students

Legend: ■ Government Scholarship   ■ Private Funding

(In the table below, each study category is split into two sub-columns: **Gov.** = Government Scholarship, **Priv.** = Private Funding.)

| Area | Countries and Regions | Undergraduate Students (Gov.) | Undergraduate Students (Priv.) | Master s Program (Gov.) | Master s Program (Priv.) | octoral Program (Gov.) | octoral Program (Priv.) | Research Students Undergraduate (Gov.) | Research Students Undergraduate (Priv.) | Research Students Graduate (Gov.) | Research Students Graduate (Priv.) | Exchange Students Undergraduate (Gov.) | Exchange Students Undergraduate (Priv.) | Students Graduate (Gov.) | Students Graduate (Priv.) | Sub-total (Gov.) | Sub-total (Priv.) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Asia | Malaysia | 35 |  |  |  | 1 | 1 |  |  |  |  |  |  |  |  | 36 | 1 | 37 |
|  | Indonesia |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 1 |  | 1 |
|  | Korea |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 1 | 1 |
|  | Mongolia | 1 | 3 | 1 |  |  |  |  |  |  |  |  |  |  |  | 2 | 3 | 5 |
|  | Vietnam |  | 10 |  | 3 |  |  |  |  |  |  |  |  |  |  |  | 13 | 13 |
|  | China |  | 6 |  | 26 |  | 17 |  | 4 |  |  |  | 6 |  | 3 |  | 62 | 62 |
|  | Taiwan |  |  |  |  | 1 | 1 |  |  |  |  |  |  |  |  |  | 2 | 2 |
|  | Cambodia | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  | 3 |  | 3 |
|  | Thailand |  |  | 3 | 1 |  | 2 |  |  |  |  |  |  |  |  | 3 | 3 | 6 |
|  | Philippines |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 1 | 1 |
|  | Nepal |  |  |  | 1 |  | 1 |  | 1 |  |  |  |  |  |  |  | 3 | 3 |
|  | Laos | 1 |  |  | 1 |  |  |  |  |  |  |  |  |  |  | 1 | 1 | 2 |
|  | Sri Lanka |  |  |  | 1 |  | 1 |  |  |  |  |  |  |  |  |  | 2 | 2 |
|  | Tajikistan |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 |
|  | Total | 40 | 21 | 4 | 34 | 3 | 23 |  | 5 |  |  |  | 6 |  | 3 | 47 | 92 | 139 |
| Middle East | Iran |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 1 |  | 1 |
|  | Total | 40 | 21 | 4 | 34 | 4 | 23 |  | 5 |  |  |  | 6 |  | 3 | 48 | 92 | 140 |
| | Total |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 140 |

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# Academic Exchange Agreements
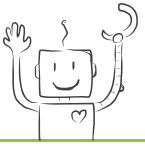
## Agreements between Universities

| Country | University | Country | Institution |
|---|---|---|---|
| Australia | University of Wollongong | India | Indian Institute of Technology Delhi |
| Bangladesh | University of Dhaka | Korea | Seoul National University |
| China | Chongqing Jiaotong University | Korea | Yeungnam University |
| China | Dailian Polytechnic Unveisity | Peru | Pontificia Universidad Catolica del Peru |
| China | Dalian University of Technology | Republic of Azerbaijan | Baku State University |
| China | Hainan University | Saudi Arabia | King Fahd University of Petroleum and Minerals |
| China | Institute of Process Engineering,Chinese Academy of Sciences | Singapore | Nanyang Technological University |
| China | North China Electric Power University | Taiwan | National Formosa University |
| China | Shenyang University of Chemical Technology | Thailand | Chiang Mai University |
| China | Xi' an Jiaotong University | U.K. | North East Wales Institute of Higher Education |
| China | Xiamen University | U.S.A | North Dakota State University |
| Czech Republic | Technical University of Ostrava | U.S.A | The State University of New York at Stony Brook, Stony Brook University |
| France | Universite'de la Me'diterrane'e (Aix-Marseille Ⅱ) |  |  |

## Agreements between Faculties

| Country | University | Country | Institution |
|---|---|---|---|
| Belgium | University of Liege | Korea | Faculty of Engineering, Mokpo National University |
| Canada | Ryerson University | Korea | Graduate School of Industry, Seoul National University of Sciend and Technology |
| China | China University of Mining and Technology | Korea | Nano-Science Research Division, Korean Institute of Science and Technology |
| China | College of Information Engineering, Yangzhou University | Korea | The Research and Education Center for Advanced Silicon materials |
| China | Fudan University | Malaysia | Faculty of Engineering and Fuel Cell Institute, Universiti Kebangsaan Malaysia |
| China | Hunan University of Science and Technology | Malaysia | Universiti Teknologi PETRONAS |
| China | School of Chemistry and Chemical Engineering, Sun Yat-sen University | Malaysia | Universiti Teknologi MARA |
| China | School of Energy and Power Engineering, Yangzhou University | Malaysia | University Malaysia Pahang |
| China | School of Instrument Science and Opto-Electronic Engineering, Hefei University of Technology | Russia | The Faculty of Food Technology and Merchandizing, The Saratov State Agrarian University named after N.I.Vavilow |
| China | School of Material Science & Engineering, Hebei University of technology | Spain | Universidad Politécnica de Valencia |
| China | School of Mechanical Engineering, Shanghai Jiaotong Daxue | Sweden | School of Engineering, University of Borås |
| China | School of Mechanical Engineering, Southwest Jiaotong University | Taiwan | College of Engineering of Iunghwa University of Science and Technology |
| China | School of Mechanical Engineering, Tsinghua University | Taiwan | I-Shou University |
| China | School of Optic & Electronic Engineering, University Shanghai For Science and Technology | Taiwan | National Chin-Yi University of Technology |
| China | School of Optoelectronics and Communication Engineering, Xiamen University of Technology | Thailand | Faculty of Agriculture and Technology Nakhon Ratchasima Campus,Rajamangala University of Technology Isan |
| China | School of Sciences, Northeastern University | Thailand | Faculty of Engineering, Chulalongkorn University |
| China | State Key Laboratory of Geohazards Prevention, Chengdu University of Technology | Thailand | Faculty of Engineering, Khon Kaen Campus,Rajamangala University of Technology Isan |
| China | Tianjin University | Thailand | Faculty of Engineering, Rajamangala University of Technology Isan, Khon Kaen Campus |
| France | Ecole Superieure D'ingenieurs en Electronique et Electrotechnique Paris | Thailand | Faculty of Industry and Technology, Rajamangala University of Technology Isan |
| France | National Graduate School of Chemistry and Chemical Engineering, The University of Montpellier | Thailand | Faculty of Science and Technology, Nakhon Pathom Rajabhat University |
| Indonesia | Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung | Thailand | Faculty of Science, Mahidol University |
| Korea | Center for Photofunctional Energy Materials, Dankook University | Thailand | King Mongkut's Institute of Technology Ladkranbang |
| Korea | Chungnam National University | Thailand | King Mongkut's University of Technology Thonburi |
| Korea | College of Engineering, Kyung Hee University | Thailand | Thai-Nichi Institute of Technology |
| Korea | College of Engineering, Kyung Hee University,Yongin,Korea | U.K. | City University |
| Korea | College of Engineering, Yonsei University | U.S.A | College of Engineering, The University of Washington |
| Korea | College of Natural Science,Chosum University | Vietnam | Faculty of Mechanical Engineering Hanoi University of Technology |
| Korea | College of Science and Technology, Yonsei University | Vietnam | Hanoi Irradiation Center, Vietnam Atomic Energy Institute |