

# **Application Guide for Winter 2020**

**Special Program of “Engineering Science 21<sup>st</sup> Century”  
for Doctoral Course in English  
Graduate School of Engineering Science, OSAKA UNIVERSITY  
“Enrollment in April 2021”**

**Special Program of “Engineering Science 21<sup>st</sup> Century”  
for Doctoral Course in English  
Graduate School of Engineering Science, OSAKA UNIVERSITY  
“Enrollment in October 2021”**

**Graduate School of Engineering Science, Osaka University**

**1-3, Machikaneyama, Toyonaka, Osaka 560-8531 JAPAN**

Email address: [ki-daigakuin@office.osaka-u.ac.jp](mailto:ki-daigakuin@office.osaka-u.ac.jp)

Website URL: <http://osku.jp/u0236>

August 2020



## 1. Date of Enrollment to the Course

**April 1<sup>st</sup>, 2021, or October 1<sup>st</sup>, 2021**

Note: Applicants must choose the desired date of enrollment on the application. This may not be changed after the application has been submitted.

## 2. Admission Capacity

For April 2021 enrollment:

A few at each of the following departments

For October 2021 enrollment:

A few at each of the following departments

Department of Materials Engineering Science

Department of Mechanical Science and Bioengineering

Department of Systems Innovation

Research areas and topics can be found at the website: [osku.jp/n0961](http://osku.jp/n0961)

## 3. Application Requirements

- (1) Eligible applicants must belong to one of the following categories:
  - (a) Non-Japanese applicants who hold a resident visa (Student Visa), the status of which permits enrollment in a Graduate School under the Immigration-Control and Refugee-Recognition Act.
  - (b) Non-Japanese applicants who are expected to obtain the above status upon enrollment in the Graduate School, under the Immigration-Control and Refugee-Recognition Act.
- (2) An applicant is required to have fulfilled at least one of the following items:
  - (a) has received a Master's degree from a university or is expected to complete a Master's course curriculum prior to the date of enrollment to our Doctoral Course;
  - (b) has either received a Bachelor's degree from a Japanese university, or completed 16 years of formal school education curriculum in countries other than Japan followed by at least 2 years of research experience at universities/research institutes, and the research achievements attained are deemed as being equivalent to Master's degree level by the Graduate School of Engineering Science, Osaka University; or
  - (c) is approved of being academically equivalent to a Master's Course graduate by the Graduate School of Engineering Science, Osaka University and is at least 24 years of age prior to the date of enrollment to our Doctoral Course.
- (3) Language ability  
Required English proficiency above 79 for TOEFL-iBT, 213 for TOEFL-CBT, 550 for TOEFL-PBT, 6.0 for IELTS or equivalent.
- (4) Health  
Applicants must be in good health and free of infectious diseases.
- (5) Attendance availability  
Applicants should arrive in Japan immediately prior to the date of enrollment and start the course on the date of enrollment.
- (6) Notes on ineligible applicants:
  - (a) Members of the armed forces are not eligible to apply.
  - (b) Admission will be revoked if a new student is not able to arrive in Japan by the designated date.

## 4. Pre-application Screening

Among the Application Requirements mentioned above, those who intend to apply for the Doctoral Course under (2)-(b), (c) are required to undergo a pre-application screening before application. Please contact the Graduate Students Section by one month before the application deadline by email ([ki-daigakuin@office.osaka-u.ac.jp](mailto:ki-daigakuin@office.osaka-u.ac.jp)) to inquire about the necessary procedures.

## 5. Application Procedure

(1) Type of Application:

Overseas application: For applicants who do not reside or are not scheduled to be in Japan at the time of screening (from the beginning of January 2021 to the middle of February 2021).

Domestic application: For applicants who reside in Japan or are scheduled to be in Japan at the time of screening (from the beginning of January 2021 to the middle of February 2021).

(2) Application Period:

**Monday, November 30, 2020 to Friday, December 11, 2020**

Note: It is essential that every applicant should **find, well in advance, a supervisor** suitable for the research field of the applicant's interest, and contact him/her by email to confirm whether the field will be appropriate for his/her laboratory. The research topics of faculty members of the Graduate School of Engineering Science can be found in the attached list and can also be available at the website: [osku.jp/n0961](http://osku.jp/n0961)

(3) Application Procedure:

Application documents should be submitted by registered *postal* mail such as Express Mail Service (EMS) so that they should arrive within the application period to the following address:

Graduate Students Section  
Graduate School of Engineering Science, Osaka University  
1-3 Machikaneyama, Toyonaka, Osaka 560-8531 JAPAN  
Phone: +81-6-6850-6146

No application will be accepted if the documents are incomplete. Once the application procedure is completed, the submitted contents cannot be altered. If any of application documents include false information, the applicant's admission will be cancelled even after he/she has enrolled.

(4) Application documents:

It is essential that all the application documents (a)-(j) be carefully completed in English with typed/printed or written in block letters (i.e. they must be written legibly in printed letters, sans-serif fonts, and not in cursive, so that they can be read easier) on A4- or US letter-sized white paper. Official English translation is required to be attached for every formal document given in other languages. Application documents are non-returnable.

- (a) Form "Application for Admission in Special Program of "Engineering Science 21<sup>st</sup> Century" for Master's Course in English" completed and signed
- (b) "Details of Proposed Study" completed in about 2,000 words on the prescribed form
- (c) Abstract of applicant's Master's thesis, written in English within 2,000 words on the prescribed form
- (d) Application fee: 30,000 yen.
  - \*Contact the Graduate Students Section well in advance regarding the method of payment.
  - \*The application fee is required to be paid to the university bank account during the application period.
  - \*Students who will graduate from the Master's Course of Osaka University have no obligation to pay the application fee.
- (e) Official document certifying the date or expected date of applicant's graduation issued and signed by the officials of the most recent university or graduate school.
- (f) Academic records, which also indicate the GPA or its equivalent and its full score, issued and signed by officials of the most recent university or graduate school.
- (g) A copy of certificate of citizenship or a copy of the applicant's passport on an A4- or US letter-sized paper.
- (h) Score report (original document) of the TOEFL test or equivalent as a certificate of English proficiency except for the cases below. Your TOEFL score may be sent to us directly from ETS. Our ETS institution code is 5413.
  - Applicants whose first language is English.
  - Applicants who have graduated from a university or a graduate school located in an English speaking country.
  - Applicants who have completed an undergraduate or graduate degree program where the language of instruction and examination was English. In this case, an official statement from the academic institution will be required, confirming the use of English as the language of instruction and examination.
  - Applicants who are on the Chemistry-Biology Combined Major Program and expected to graduate from any of the following prior to the date of enrollment to the course: the School of Science,

Engineering, or Engineering Science at Osaka University.

- (i) Recommendation letter from the Dean of the faculty or school, the Head of the department, or the applicant's academic supervisor in the institution from which the applicant has graduated. When the applicant is an employee, a recommendation letter from the employer/executives will also be accepted.
- (j) One (1) photo 3.2 by 2.6 cm in size
  - Color
  - Printed on photo quality paper
  - Taken within the last 6 months prior to the application date to reflect the current appearance
  - Taken clearly in front of a plain background
  - Taken in full-face view directly facing the camera including upper body
  - With a neutral facial expression and both eyes open. Do not wear a hat or head covering.
  - Write your name and nationality in block letters on the back of the photo
  - Attach the photo with a paperclip on the form "Application for Admission in Special Program of "Engineering Science 21<sup>st</sup> Century" for Doctoral Course in English" (Do not paste.)

## 6. Screening

- (1) **Overseas application:** screening will be held on the basis of the application documents and internet interview by the end of January 2021.
- (2) **Domestic application:** screening will be held on the basis of an oral/paper examination, and the application documents by the middle of February 2021.

Note: The details of the exams for both overseas as well as domestic application will be provided by the host professor or the division (section) supervisor.

## 7. Notification of Results

- (1) **Overseas application:** The results of screening will be mailed to the applicants **by the middle of February 2021.**
- (2) **Domestic application:** The results of screening will be mailed to the applicants **by the end of February 2021.**

Note: Inquiry about the results by telephone etc. is strictly prohibited.

## 8. Enrollment Formalities

- (1) Documents to be submitted: Graduation certificate, certified academic records.  
Regarding the certificates, if applicants have submitted documents based on the prospect of completion/graduation at the time of application, please remember that the official documents must be submitted at the time of the admissions process.
- (2) Payment of fees:  
**Admission fees: 282,000 JPY**  
**Tuition fees: 535,800 JPY per year**

Note:

- (a) Students supported by a Japanese Government Scholarship (Monbukagakusho Scholarship) are exempt from both admission fees and tuition fees.
- (b) A financial aid plan is made available to students: either half or all of the admission fee and/or tuition fee may be waived. Eligibility for a financial aid plan is based on financial need and academic achievement, or in the case of suffering from natural disasters.
- (c) If admission fees and tuition fees are revised by the University, the students are required to pay the revised amount.

## **9. Policy on Handling Personal Information**

- (1) Names, addresses, and other personal information will be used in the entrance examination process, in the publication of the list of successful applicants, and in the admission procedures. For those admitted to Osaka University, personal information will also be used for academic-related matters (keeping academic and registration records), for student support matters (health care management, school fee exemptions and applications for scholarships, career support, etc.), and for school fee management.
- (2) The information obtained from the entrance examination such as grade statistics and analysis will be used for research on admission methods.

## **10. Security Export Control**

At Osaka University, Security Export Control is conducted in accordance with the “Foreign Exchange and Foreign Trade Act” for the purpose of maintaining the peace and security of Japan and the international community. Applicants who fall under the conditions set out in said regulations may not be able to enroll in their desired course or program or carry out research activities.

## **11. Note**

Applicants are recommended to become well acquainted with the Japanese language, culture, customs, and so on. Knowledge of Japanese would prove to be useful for daily life.

## **12. Requests for Application Forms**

Application forms can be downloaded from the website: [osku.jp/x0676](http://osku.jp/x0676)

For any matters concerning admission, please contact the Graduate Students Section by email:

Graduate Students Section  
Graduate School of Engineering Science, Osaka University  
1-3, Machikaneyama, Toyonaka, Osaka 560-8531 JAPAN  
Email: [ki-daigakuin@office.osaka-u.ac.jp](mailto:ki-daigakuin@office.osaka-u.ac.jp)

## Department of Materials Engineering Science

Division	Area	Research Group	Keywords	Professor
<b>Materials Physics</b>	Electron Correlation Physics	Theoretical Research Group of Strongly Correlated Systems	Topological insulators and superconductors, Exotic superconductors, Strongly correlated electron systems, Quantum magnetism, Quantum criticality, Mathematical physics	Prof. FUJIMOTO Satoshi
		Experimental Research Group for Spectroscopy of Correlated Materials	Polarization-dependent bulk-sensitive photoelectron spectroscopy ( hard X-ray and extremely low-energy excitation), Bulk-sensitive soft x-ray angle-resolved photoemission and their dichroism	Prof. SEKIYAMA Akira
		Experimental Research Group for Electron-correlated Matter Science	Exotic superconductors, Topological superconductors, Quantum critical systems, Multipolar systems, Strongly correlated electron systems, Angle-resolved thermal-transport/thermodynamic measurements under extreme conditions	Prof. IZAWA Koichi
	Quantum Physics of Nanoscale Materials	Quantum Information and Quantum Optics Group	Quantum information processing, Entanglement manipulation, Quantum optics, Atom Optics, Optomechanics	Prof. Takashi Yamamoto
		Group for Exploration of Functional Materials	Magnetism, Ferroelectricity, Correlated electron systems, Oxides, Crystal growth	Prof. Shintaro Ishiwata
		Experimental Research Group for Nanoscience	Nanostructures, Spintronics	Prof. SUZUKI Yoshishige
	Quantum Materials Physics	Interface Quantum Science	Spintronics, Flexible Spintronics, Advanced magnetic engineering, Control of magnetism, Functional quantum interface	Prof. Daichi Chiba
Condensed Matter Theory		First-principles calculation, Condensed matter theory, Materials prediction and design, Magnetism, Ferroelectricity, Superconductivity, Multiferroics	Prof. OGUCHI Tamio	
<b>Chemistry</b>	Synthetic Chemistry	Synthetic Organic Chemistry Group	Environmentally benign process for molecular transformations, Simulation of enzymatic functions with metallo- and organocatalysts, Creation of functional organometallics	Prof. NAOTA Takeshi
		Physical Organic Chemistry Group	Reaction Development, Mechanistic Analysis, Functional Molecule Synthesis, Structure-Property Evaluation, Catalytic Reaction, Asymmetric Catalysis	Prof. SHINTANI Ryo
		Molecular Assembly Chemistry Group	Supramolecular chemistry, Crystal engineering, Functional crystalline material, Porous organic framework, Carbon dioxide absorbent, Hydrogen bond	Prof. HISAKI Ichiro
	Molecular Organization Chemistry	Surface Chemistry Group	Energy Conversion, Electrode Interfaces, Ionic Liquid Interfacial Chemistry, Catalytic Reaction Mechanism, Chemical Sensor, Interfaces of Electrochemical Devices	Prof. FUKUI Ken-ichi
		Biological Chemistry Group	Nucleic acids chemistry, Chemical synthesis of oligonucleotides, DNA damage, DNA repair, Biomolecular recognition, Protein–nucleic acid interactions	Prof. IWAI Shigenori
	Solar Energy Chemistry	Solar Energy Conversion	Artificial Photosynthesis; Natural Photosynthesis; Light-to-chemical energy conversion; Photofunctional materials; Electrocatalytic reactions; Next-generation secondary batteries	Prof. NAKANISHI Shuji
<b>Chemical Engineering</b>	Chemical Reaction Engineering	Nanoreaction Engineering Group	Chemical reaction engineering, porous materials, inorganic membranes, liquid crystals	Prof. NISHIYAMA Norikazu
		Quantum Chemical Engineering group	Quantum nonlinear optics, Materials-oriented quantum chemistry, Open-shell molecular systems, Quantum dynamics	Prof. NAKANO Masayoshi
		Design of High-Performance Catalyst Group	Catalytic chemistry, Catalyst design, Green chemistry, Environmentally-benign catalytic process, Green organic synthesis, Inorganic crystallites, Nanocluster, Highly ordered multicomponent catalyst	Prof. MIZUGAKI Tomoo
	Environment and Energy System	Transport Phenomena Control Group	Control of Heat and Mass Transfer, Liquid-Liquid Interface, Phase Change, Computational Fluid Dynamics	Prof. OKANO Yasunori
		Molecular-Aggregate Chemical Engineering Group	Soft Self-Organizing System, Distribution of Molecule at Mesoscale, Amphiphilic Molecule, Ionic Liquid, Molecular Simulation, Solution Theory	Prof. MATUBAYASI Nobuyuki
	Bioprocess Engineering	Bio-Inspired Chemical Engineering Group	Bio-Inspired Chemical Engineering, Self-Assemblies, Engineering Science of Liposome, Molecular Recognition, Artificial Enzyme, Bioseparation	Prof. UMAKOSHI Hiroshi
		Biochemical Materials Engineering Group	Biomedical, Biomaterial, Tissue fabrication, Hydrogel, Soft matter, Biochemical engineering	Prof. SAKAI Shinji
Solar Energy Chemistry	Environmental Photochemical Engineering Group	Photocatalysts, Highly Selective Transformation of Organic Compounds, Artificial Photosynthesis, Photoluminescent Molecular Devices and Sensors	Prof. HIRAI Takayuki	
<b>Frontier Materials Science</b>	Frontier Materials	Molecular Architectonics Research Group	Experimental and Theoretical Studies on Molecular-based and Molecular-scale Electronics, Spintronics and Thermoelectronics, and on Novel Molecular Architectures utilizing Fluctuations towards Brain-like Devices	Prof. TADA Hirokazu
		Organometallic Chemistry Group	Design and Synthesis of Homogeneous Molecular Catalysts, Organometallic Complexes, Metal Nanoclusters, Chiral Complexes, and Molecular Devices	Prof. MASHIMA Kazushi
		Theory Group of Advanced Materials Science	Microscopic theory of light-matter interaction, Photo-functional design with nano-materials, Optical manipulation of nanostructures, Theory of nonlinear optical response of solids (Elucidation and prediction of new phase of matters under extreme conditions, The first-principles calculations and its development based on the quantum simulation)	Prof. ISHIHARA Hajime (Assoc. Prof. KUSAKABE Ko-ichi)
	Dynamics of Nanoscale Materials	Experimental Research Group for Coherence of Nanoscale Materials	Optical properties of semiconductor ultrathin films and nanoparticles, and strongly-correlated electron systems, Nonlinear laser spectroscopy, Ultrafast time-resolved spectroscopy, THz spectroscopy, SEM-cathodoluminescence, Optical fabrication and manipulation of nanoparticles	Prof. ASHIDA Masaaki
		Experimental Research Group for Fluctuation Dynamics in Condensed Phase	photochemistry, photofunctional molecule, three-dimensional three-pulse photon echo, ultrafast detection of photochemical reactions, laser-control of chemical reactions, time-resolved microscopy, single-molecule measurement, biomolecular fluctuation	Prof. MIYASAKA Hiroshi
	Quantum Science in Extreme Conditions	Experimental Research Group for Materials Science in Extreme Conditions	Material science at extreme conditions; Superconductivity, magnetism, structural phase transitions, new material and new function	Prof. SHIMIZU Katsuya
		Experimental Research Group for Materials Engineering Science in Nano-structure	Nano-fabrication of solids and semiconductors, Hetero-structure of oxides, Nano-materials device, Electronics of functional oxides	Prof. TANAKA Hidekazu

## Department of Mechanical Science and Bioengineering

Division	Area	Research Group	Keywords	Professor
<b>Nonlinear Mechanics</b>	Mechanics of Fluids and Thermo-fluids	Thermal Engineering and Science Group	Subcritical transition to turbulence, Fully developed turbulence, Flow control, Heat transfer enhancement, Drag reduction	Prof. KAWAHARA Genta
		Fluid Mechanics Group	Science and technology of nonlinear phenomena in fluid mechanics, Transport and mixing, Turbulent flows, Granular flows, Flows of complex fluids, Interfacial flows	Prof. GOTO Susumu
	Mechanics of Solid Materials	Structure and strength of materials group	Dynamic evaluation of hydrogen embrittlement of metals, Material properties of hydrogen energy materials, Development of new materials by means of impact compression, Development of nano-diamond composites, Biomimetics of plants structure	
		Solid Mechanics Group	Theory of elasticity, Isogeometric analysis, Multiscale analysis, Mechanics of defects in solid, Large scale computation, Structure optimization, Resonant ultrasound spectroscopy, Gas sensor, Dynamics of colloidal materials	Prof. TARUMI Ryuichi
<b>Mechanical Engineering</b>	Propulsion Engineering	Molecular Fluid Dynamics Group	Control and analysis of nanoparticle flow dynamics by optical pressure and optical vortex, Development of micro-machined artificial auditory sensory epithelium using AI, Molecular fluid sciences of single-molecule measurement technology, Integration of Deep Learning to intelligent flow measurement and simulation	Prof. KAWANO Satoyuki
		Fluids Engineering Group	Multiphase Flows, Cavitating Flows, Flow Control, Numerical Scheme and Algorithm, High Performance Computing, Optical Measurements	Prof. SUGIYAMA Kazuyasu
	Mechano-informatics	Human Motor Control and Human Enhancement Group	Computer assisted surgery, Medical robotics, Endoscopic surgery assistance, Skilled and coordinated movements, Functional electrical stimulation, Neurorehabilitation, Sports science, Human enhancement technology	Prof. NISHIKAWA Atsushi
		Theoretical Solid Mechanics Group	Multiscale-multiphysics modeling for the deformation, fracture, corrosion, and friction behaviors of materials, Prediction and design of the mechanical properties of materials, Electronic and atomistic simulation, Micro-Meso-Macro-mechanics, Machine learning, Structural materials with high strength and ductility, High-entropy alloys, Materials with mille-feuille structures, Nanostructured materials, Amorphous materials, Nano-materials	Prof. OGATA Shigenobu
<b>Bioengineering</b>	Biomechanical Science	Biomechanics Group	Biomechanics of cells, tissues, and organs, Functional adaptation and remodeling, Computational biomechanics, Biofluid dynamics, Biomechanical Imaging, Biomolecular dynamics	Prof. WADA Shigeo
		Mechanical and Bioengineering Systems Group	Biomechanical System Modeling, Biomechanical Simulation, Orthopaedic/Dental Biomechanics, Musculo-Skeletal Dynamics, Rehabilitation Engineering, Welfare Engineering, Assistive Technology, Adaptive Structures and Systems, Optimum/Adaptive Structural Design, Smart System Design	Prof. TANAKA Masao
		BioMedical Engineering	Medical Device, Artificial Organs, Biosensing, Bioinformation Monitoring, Biomaterials, Medical Imaging	Guest Prof. TSUKIYA Tomonori
	Biophysical Engineering	Bio-Dynamics Group	Human motor control, Posture and Gait, Neuro-mechanics, Neuro-rehabilitation, Neuro-engineering, Biomedical Engineering, Computational Neuroscience, Systems Physiology, Biosignal processing, Nonlinear dynamical system theory and its application to physiology and medicine	Prof. NOMURA Taishin
		Biological Physics and Data Science Group	Biological statistical physics, Nonlinear time series analysis and its application to biosignals, Biomedical big-data analysis, Healthcare cyber-physical system.	Prof. KIYONO Ken
	Biomedical and Biophysical Measurements	Molecular BioMeasurement Group	Cellular adaptation to mechanical environment, Physical/biochemical properties of cells and subcellular components, Bioengineering-based drug repositioning, Cell biomechanics/biophysics and mechanobiology, Soft matter physics, Microfluidics	Prof. DEGUCHI Shinji
		Bioimaging Group	Smart Sensing, Presentation, Multipurpose Display, VR/AR, Computer Vision, SLAM, Image Measurement, Sensory Information Processing, Mechatronics, Functional Material, Digital Fabrication, Soft Mechanism, Food Design	Prof. OSHIRO Osamu



## Department of Systems Innovation

Division	Area	Research Group	Keywords	Professor
<b>Advanced Electronics and Optical Science</b>	Solid State Electronics	Nanoelectronics Group	Nitride semiconductor materials, Memristor, Group-IV semiconductor materials, AI electronics, Synchrotron radiation nanobeam X-ray diffraction, Scanning probe microscopy, Transmission electron microscopy, Quantum beam nanofabrication, First principles calculation	Prof. SAKAI Akira
		Nanostructure Physics Group	Nanostructure physics, Low-dimensional structures / Superlattices, Thermoelectric conversion, Phonon engineering, Group-IV semiconductor materials, Transparent oxide materials, Molecular beam epitaxy	Prof. NAKAMURA Yoshiaki
		Nano-scale Physics & Device Group	Semiconductor spintronics, Low-temperature MBE, Metal/Semiconductor interface, Semiconductor/Oxide interface, Interfacial multiferroics	Prof. HAMAYA Kohei
	Advanced Quantum Devices and Electronics	Quantum Computing Group	Quantum computer, Quantum algorithm, Quantum complexity theory, Quantum error correction, Fault-tolerant quantum computing, Quantum machine learning, Quantum information theory, Quantum dynamics	Prof. FUJII Keisuke
		Advanced Quantum Information Device Group	Quantum measurement and sensing, Ultra high-sensitivity MRI/NMR, Room temperature hyper polarization, Quantum sensitive coding, Quantum information experiment	Prof. KITAGAWA Masahiro
	Optical Electronics	Microwave Photonics Group	Artificial metamaterials, Transformation optics, Invisibility cloaks, Left-handed materials, Photonics crystals, Plasmonic devices, Microwaves, Wireless communications	Prof. SANADA Atsushi
		Information Photonics Group	Millimeter- and terahertz-wave photonics, Nano-structure photonics, Metamaterials, Ultrafast electronics, Photonic signal processing and measurement, Communication systems	Prof. NAGATSUMA Tadao
		Quantum Electronics Group	Laser cooling, Quantum information, Quantum optics, Ion trap, Laser stabilization, Frequency standard	Prof. MUKAIYAMA Takashi
Advanced Electronics Under Extreme Conditions	Advanced Electronics Group	Atom technology, Nanobiology, Nanoelectronics, Scanning Probe Microscopy, Medical Engineering, Nanometer analysis and characterization	Prof. ABE Masayuki	
<b>Systems Science and Applied Informatics</b>	System Theory	Adaptive Robotics Group	Soft Robotics, Embodied Artificial Intelligence, Bio-mimetic Robotics, Bio-Robotics, Muscular-skeletal Robots, Humanoid Robots	Prof. HOSODA Koh
		Systems Analysis Group	Signals and Systems Analysis, Adaptive System, Speech Intelligibility, Active Noise Cancellation, Image Understanding and Restoration, Feature Extraction and Classification	Prof. IIGUNI Youji
	Intelligent Systems	Robot Learning Group	AIxRobotics, Machine Learning, Symbol Emergence in Robotics, Developmental Cognitive Robotics, Domestic Service Robots, Emotional Intelligence, Haptic Intelligence, Child-Robot Interaction	Prof. NAGAI Takayuki
		Intelligent Robotics Group	Human-Robot Interaction, Android Science, Communication robots, Learning and cognitive developmental Robot, Bio-mimetic system, Intelligent sensor network, Pattern recognition, Brain-Machine Interface	Prof. ISHIGURO Hiroshi
		Pattern Measurement Group	Computer Vision, Visual Media, Olfactory Media, Virtual Reality, Augmented/Mixed Reality, Intelligent Sensing, Human Activity Sensing, Sensor Fusion, Digital Archive, Human Interface, Human Augmentation	Prof. SATO Kosuke
		Robotic Manipulation Research Group	Robot Manipulator, Motion Planning, Assembly, Human-Computer Interaction, Social Computing, Augmented Reality	Prof. HARADA Kensuke
<b>Mathematical Science</b>	Mathematical Modelling	Differential Equation Group	Nonlinear partial differential equations, Variational methods, Singularity formation, Mathematical fluid dynamics, Mathematical sciences	Prof. KOBAYASHI Takayuki
		Applied Analysis Group	Mathematical models of phenomena, Nonlinear analysis, Nonlinear differential equations, Variational methods, Dynamical systems, Blow-up analysis, Mathematical physics, Critical phenomena	Prof. ISHIWATA Michinori
	Statistical Science	Statistical Analysis Group	Sparse Estimation, Bayesian Networks, Machine Learning, Information Theory, Bioinformatics, Bayes Statistics, Information Geometry, Quantum Tomography	Prof. SUZUKI Joe
		Statistical Science Group	Multivariate analysis, Structural equation modeling, Statistical causal inference, information loss, time series analysis, model selection	Prof. KANO Yutaka
<b>Mathematical Science for Social Systems</b>	Mathematical and Statistical Finance	Research Group of Statistical Inference	Statistical inference for stochastic processes, High frequency data analysis, Actuarial mathematics, Monte Carlo methods, Bayesian Statistics, Mathematical statistics, Fractional Brownian motion	Prof. UCHIDA Masayuki
		Research Group of Mathematical Modeling in Finance	Dynamic utility maximization, Stochastic optimal control, Differential game, Dynamic programming equation, Insurance mathematics, Levy processes, Quantitative risk management	Prof. SEKINE Jun
		Research Group of Stochastic Analysis	Stochastic integration, Stochastic differential equations, Fractional Brownian motion, Rough path analysis, Mathematical Finance, Quantitative Finance, Computational Finance, Financial engineering	Prof. FUKASAWA Masaaki
	Theoretical Systems Science	Research Group of Complex Systems	System theory, Formal method, Discrete event system, Hybrid system, Cyber-physical system, Deep learning, Model-based machine learning, Reinforcement learning	Prof. USHIO Toshimitsu
		Research Group of Systems Optimization and Decision Making	Decision making, Systems optimization, Multiple criteria decision aiding, Fuzzy logic, Management of uncertainty, Data mining, Soft Computing, Rule induction	Prof. INUIGUCHI Masahiro



# Special Program of “Engineering Science 21<sup>st</sup> Century”

## Master’s and Doctoral Courses in English

### Study Contents

The Graduate School of Engineering Science aims to acquire a strong international reputation through increased exchange of students and researchers, and in joint research projects. For this objective, the Graduate School of Engineering Science has decided to offer a new interdisciplinary program in which all lectures, as well as all instructions and supervision in research-related activities and seminars, are given in English. The students are not required to learn Japanese to join this program. In this program, globally recognized and highly qualified graduates are expected to be educated under the guiding principles of the Graduate School of Engineering Science: integrating science and technology.

### Outline and Features of the Program

- 1) The aim of this program is to develop human resources with high level, creative and flexible problem-solving ability. This is achieved through multi- and interdisciplinary research training, seminars, and lectures, given by prominent professors in their respective fields.
- 2) Students are guided and supervised in English.
- 3) Students can select one of the **eleven “Divisions”** of the Graduate School of Engineering Science (see **Table 1**), for their research study for a Master’s or Doctoral Degree. Students will be required to choose one professor as their supervisor.
- 4) The opportunity for an internship at a prominent Japanese company or research organization will be provided in order to increase the knowledge and experience of cutting-edge technologies. This internship will allow international students to become discerning and well-balanced scientists, with a deeper understanding of the Japanese society. The internship will also meet the requirements of those international students who wish to have practical experience in industry.
- 5) The program also provides the opportunity to enhance interactions between Japanese and international students. The program will improve the international awareness of Japanese students, as well as deepen international students’ understanding of the Japanese society. This will also meet the demands of those Japanese students who want to work in the global environment.

### Course Requirements

- 1) **Master’s Course students** are required to obtain 30 credits, as given in **Table 2**. The list of lectures given in English is shown in **Table 3**.
- 2) **Doctoral Course students** are required to obtain 12 credits in “Advanced/Special Research I to VI” for each division as well as to take “Research Training for Doctor's Thesis” with no credit.

**Table 1. Departments and Divisions of the Graduate School of Engineering Science**

## **Department of Materials Engineering Science**

### **Division of Materials Physics**

- Area of Electron Correlation Physics
- Area of Quantum Physics of Nanoscale Materials
- Area of Quantum Materials Physics

### **Division of Chemistry**

- Area of Synthetic Chemistry
- Area of Molecular Organization Chemistry
- Area of Solar Energy Chemistry

### **Division of Chemical Engineering**

- Area of Chemical Reaction Engineering
- Area of Environment and Energy System
- Area of Bioprocess Engineering
- Area of Solar Energy Chemistry

### **Division of Frontier Materials Science**

- Area of Frontier Materials
- Area of Dynamics of Nanoscale Materials
- Area of Quantum Science in Extreme Conditions

## **Department of Mechanical Science and Bioengineering**

### **Division of Nonlinear Mechanics**

- Area of Mechanics of Fluids and Thermo-fluids
- Area of Mechanics of Solid Materials

### **Division of Mechanical Engineering**

- Area of Propulsion Engineering
- Area of Mechano-informatics

### **Division of Bioengineering**

- Area of Biomechanical Science
- Area of Biophysical Engineering
- Area of Biomedical and Biophysical Measurements

## **Department of Systems Innovation**

### **Division of Advanced Electronics and Optical Science**

- Area of Solid State Electronics
- Area of Advanced Quantum Devices and Electronics
- Area of Optical Electronics
- Area of Advanced Electronics Under Extreme Conditions

### **Division of Systems Science and Applied Informatics**

- Area of System Theory
- Area of Intelligent Systems

### **Division of Mathematical Science**

- Area of Mathematical Modelling
- Area of Statistical Science

### **Division of Mathematical Science for Social Systems**

- Area of Mathematical and Statistical Finance
- Area of Theoretical Systems Science

**Table 2. Requirements for Master's Course**

Category	Number of Credits
Lectures	18
Seminar I~IV in each division	4
Research I~IV in each division	8

**Table 3. List of lectures of Master's Course**

○=Annual classes    \* =Biennial classes

Lectures	Credits
Solid State Spectroscopy	2(○)
Science and Engineering of Correlated Electron Materials	2(○)
Introduction to magnetism and spintronics	2(○)
Advanced magnetism and spintronics	2(○)
Properties of Materials	2(○)
Bio-Inspired Chemical Engineering	2(○)
Molecular Nanotechnology	2(○)
Theoretical Materials Science	2(○)
Photophysics of Nanoscale Materials	2(○)
Frontier of Nano-scale Materials	2(○)
International Exchange Lecture on Nanoscience and Nanoengineering A	1(○)
International Exchange Lecture on Nanoscience and Nanoengineering B	1(○)
International Exchange Lecture on Nanoscience and Nanoengineering C	1(○)
Turbulence Dynamics	2(*)
Advanced Fluid Mechanics	2(*)
Advanced Experimental Mechanics	2(*)
Vibrations and Waves	2(*)
Topics in Multiphase Flow Engineering	2(*)
Topics on Robotics	2(*)
Stability Analysis of Dynamical Systems	2(*)
Advanced Theoretical Solid Mechanics	2(*)
Advanced Computational Mechanics	2(*)
Biomechanics	2(*)
Theory of Optimum Design and Synthesis	2(*)
Biomechanism	2(*)
Biomedical data science	2(*)
Biosystem Engineering	2(○)
Engineering in biology and medicine	2(*)
Medical Virtual Reality	2(*)

Lectures	Credits
Quantum Information Science	2(*)
Advanced Optoelectronics	2(○)
Systems and Control Theory	2(*)
Adaptive Systems Theory	2(*)
Signal Analysis Theory	2(*)
Theory of Systems Analysis	2(*)
Applied Robotics	2(*)
Intelligent Robotics	2(*)
Mixed Reality Systems	2(*)
Advanced Robot Systems	2(*)
Imaging Systems	2(*)
Database Systems	2(*)
Communication Robot	2(*)
Intelligent Learning System	2(*)
Topics in Mathematical Sciences 1	1(*)
Topics in Mathematical Sciences 2	1(*)
Topics in Mathematical Sciences 3	1(*)
Topics in Mathematical Sciences 4	1(*)
Topics in Mathematical Statistics 1	1(*)
Topics in Mathematical Statistics 2	1(*)
Topics in Mathematical Statistics 3	1(*)
Topics in Mathematical Statistics 4	1(*)
Data Science and Case Studies I	2(○)
Nonlinear System Theory	2(○)
Systems Optimization and Analysis	2(*)
Intelligent Mathematical Programming System	2(*)
Introduction to Engineering Science	2(○)
Advanced Physical Chemistry	2(○)
Advanced Organic Chemistry	2(○)
Advanced Chemistry for Material Science	2(*)
Material Process Engineering	2(*)
Biochemical Materials Engineering	2(*)
Solid State Devices	2(○)
Opto- and Quantum Electronics	2(○)
Advanced Mathematical Science A	2(○)
Advanced Mathematical Science B	2(○)
Advanced Mathematical Science C	2(○)
Engineering Science Research Internship 1	1(○)
Engineering Science Research Internship 2	2(○)

# Graduate School of Engineering Science

## OSAKA UNIVERSITY

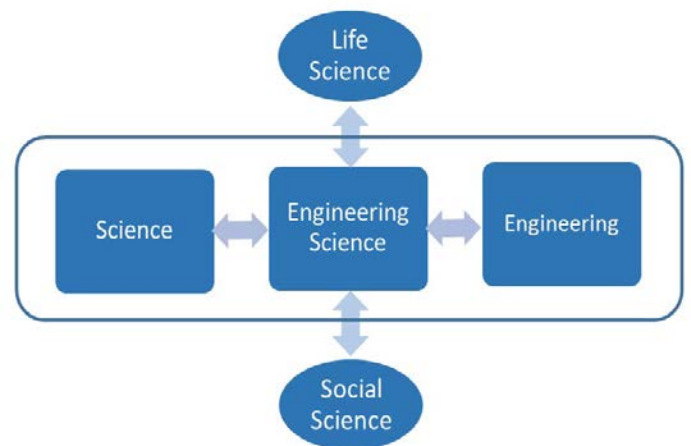
### 1. Message from the Dean

Welcome to the Graduate School of Engineering Science/School of Engineering Science, Osaka University

As we well know, science and engineering had developed tremendously during the 20th century, so that subsequently our lives have been changed and improved drastically. The extension and formalization of the fundamental disciplines and their applications to manufacturing played an important role of the developments. We believe that fusing together as well as developing the fundamental disciplines are necessary steps toward continuing to contribute to developments in the future. In addition, we incorporate the fruits from humanity and social science research with those from science and engineering in order to create true culture of the human being.

Since the foundation of the School of Engineering Science in 1961, we have continuously created interdisciplinary research fields congruent with social needs and have made a great contribution to the academy and industry through research and education. Osaka University offers great and unique opportunities of education and research in the wide range of the fields of basic science, engineering science and manufacturing. In addition, our graduate school attempts to connect life science with the engineering science and further progress toward the integration of arts and science, which includes financial engineering and insurance, robotics and data science.

In the School of Engineering Science, which has ten courses, we have organized a characteristic curriculum for each course to provide a deep knowledge of basic subjects, such as mathematics, physics, chemistry, biology and informatics, as well as major important subjects related to the courses. Our education also develops wider viewpoints and flexibility. In the Graduate School, with eleven divisions, we provide higher-level professional education and perform fusion research with the different areas. We attempt to produce graduates who have a firm specialty and the potential to pursue research and development in areas beyond their acquired specialty.



Dean  
Graduate School of Engineering Science,  
Osaka University

*Yutaka Kano*

### 2. Outline of the Graduate School of Engineering Science

In the modern world, progress in technology is founded on the achievements in science, and these advances must be supported by continually developing technology. Technology and science are thus tightly knit together. The necessity of reflecting on this situation in research and education, particularly at Osaka University which is located in a major industrial area, was emphasized by Dr. Kenjiro Shoda while he was president of the university. Plans were laid out by Dr. Shoda to establish a new school for this purpose, rather than to extend the School of Science and School of Engineering which had their own separate aims. Through his efforts and those of former university President Dr. Shiro Akabori, together with support from the industry in and

outside of Osaka, the School of Engineering Science came into existence in April 1961, and the Graduate School of Engineering Science was opened in April 1964.

The School and Graduate School are unique in name and character in Japan. Their purpose is to develop scientists with a keen interest in practical technology and engineers with a firm grasp of the basic sciences, who may use their expertise to develop new technology.

In April 1997, the departments of the Graduate School of Engineering Science were reorganized by restructuring the old departments into four departments: "Physical Science", "Chemical Science and Engineering", "Systems and Human Science", and "Informatics and Mathematical Science".

In April 2002, some groups in "Systems and Human Science" and "Informatics and Mathematical Science" moved to the newly founded graduate schools of Osaka University: Information Science and Technology, and Frontier Bioscience. They play important roles in education and research of these new areas.

In April 2003, Graduate School of Engineering Science was reorganized in order to create new research fields in the multi- and inter-disciplinary areas. The new Graduate School of Engineering Science has three departments: "Department of Materials Engineering Science" dealing with physical and chemical materials from a unified view point of materials science, "Department of Mechanical Science and Bioengineering" dealing with mechanical science and bioengineering from the view point of applied mechanics, and "Department of Systems Innovation" dealing with electronics, systems and mathematics from the view point of system creation.

### 3. Historical Sketch

<p>School/Graduate School of Engineering Science Established in</p> <p>1961 — Department of Mechanical Engineering Department of Chemistry Department of Electrical Engineering Common Chairs (Mathematical Science)</p> <p>1962 — Department of Control Engineering Department of Material Physics</p> <p>1963 — Department of Chemical Engineering</p> <p>1964 — Graduate School of Engineering Science Mathematical Science Course Physical Science Course Chemical Science Course</p> <p>1967 — Department of Biophysical Engineering</p> <p>1970 — Department of Information and Computer Sciences</p> <p>1992 — Department of Systems Engineering (reorganized from Department of Control Engineering)</p> <p>1996 — Department of Chemical Science and Engineering (reorganized from Department of Chemistry and Department of Chemical Engineering) Department of Information and Computer Sciences (reorganized from Department of Information and Computer Science and Common Chairs (Mathematical Science)) Graduate School of Engineering Science was reorganized as follows:</p>	<p>Department of Chemical Science and Engineering Department of Informatics and Mathematical Science</p> <p>1997 — Department of Electronics and Materials Physics (reorganized from Department of Electrical Engineering and Department of Material Physics) Department of Systems Science (reorganized from Department of Mechanical Engineering, Department of Systems Science and Department of Biophysical Engineering) Graduate School of Engineering Science was reorganized as follows: Department of Physical Science Department of Systems and Human Science</p> <p>2002 — Graduate School of Information Science and Technology Graduate School of Frontier Bioscience</p> <p>2003 — Graduate School was reorganized as follows Department of Materials Engineering Science Department of Mechanical Science and Bioengineering Department of Systems Innovation</p> <p>2014 — Center for Science and Technology under Extreme Conditions Center for Promotion of Advanced Interdisciplinary Research</p> <p>2016 — Center for Spintronics Research Network</p> <p>2017 — Center for Industry-University Collaboration</p>
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# Special Program of “Engineering Science 21<sup>st</sup> Century” In English Graduate School of Engineering Science, Osaka University

