

# **Application Guide for Summer 2024**

**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 2024”**

**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 2025”**

**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 2023

## 1. Date of Enrollment to the Course

**October 1<sup>st</sup>, 2024, or April 1<sup>st</sup>, 2025**

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

## 2. Maximum Number for Admission

For October 2024 enrollment:

A small number of students at each of the following departments

For April 2025 enrollment:

A small number of students 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 on 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 must fulfill at least one of the following three conditions:
  - (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 bring 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) Notes on ineligible applicants:
  - (a) Students who are not expected to have a resident visa (Student Visa) at the time of admission. Please consult the Graduate Students Section if necessary.
  - (b) Members of the armed forces.

## 4. Pre-application Screening

Among the Application Requirements mentioned above, those who intend to apply for the doctoral course under 3-(2)-(b), (c) are required to undergo a pre-application screening before applying. Please contact the Graduate Students Section at least 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 middle of July 2024 to the middle of August 2024).

Domestic application: For applicants who reside in Japan or are scheduled to be in Japan at the time of screening (from the middle of July 2024 to the middle of August 2024).

(2) Application Period: **Monday, June 24, 2024 to Friday, July 5, 2024**

(3) Application Process :

Applicants must go through the application process as seen below.

- i) Every applicant should find, well in advance, a supervisor suitable for the research field of the applicant's interest. The research topics of faculty members of the Graduate School of Engineering Science can be found in the attached list and is also available at the website: [osku.jp/n0961](http://osku.jp/n0961)
- ii) It is essential that every applicant should contact the professor with whom the applicant wishes to work and obtain the professor's permission to apply.
  - If the applicant's most recent university of graduation (including expected graduation) is located overseas, before contacting the professor, in principle, every applicant is strongly encouraged to apply to the "Osaka University Admissions Assistance Desk (hereinafter called "AAD") first and obtain permission to contact the professor.
  - If the applicant's most recent university of graduation (including expected graduation) is located in Japan, he/she does not have to go through AAD and should contact the professor directly.

\*Osaka University has established the AAD for those who have graduated (or expect to graduate) from an overseas university, and this will be a means to accurately and efficiently submit their applications and other documents to the desired supervisor. In order to welcome those who have graduated (or expect to graduate) from an overseas university in an efficient manner, those who are planning to come to the Graduate School of Engineering Science are strongly encouraged to apply through the AAD. Applicants who are currently enrolled at the Graduate School of Engineering Science are not required to apply to the AAD. For further details regarding the AAD: [osku.jp/z0881](http://osku.jp/z0881)

Important note:

Please keep in mind that the AAD serves to notify you whether or not you will be permitted to contact the professor, and that receiving such a notification does not mean that you have been accepted. In addition, note that it will take roughly three weeks after you have applied before you receive this notification. We suggest that you apply for AAD well in advance, at least three weeks before applying for admission.

iii) 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.

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

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 Doctoral 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/entrance examination fee: 30,000 yen.

\*Contact the Graduate Students Section well in advance regarding the method of payment.

\*The application fee/entrance examination 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 and subsequently wish to continue their studies by advancing to the doctoral course have no obligation to pay the

- application/entrance examination 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, 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.
  - (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) Two (2) photos 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
    - One should be pasted directly on the form "Application for Admission in Special Program of "Engineering Science 21<sup>st</sup> Century" for Doctoral Course in English". The other should be attached with a paperclip (do not paste this one).

## 6. Screening

- (1) **Overseas application:** Screening will be held based on the application documents and internet interview by the beginning of August 2024.
- (2) **Domestic application:** Screening will be held based on an oral/paper examination, and the application documents by the middle of August 2024.

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 screening results will be mailed to the applicants **by the middle of August 2024.**
- (2) **Domestic application:** The screening results will be mailed to the applicants **by the end of August 2024.**
  - Admission decisions are non-negotiable.
  - The Graduate Students Section will not respond to any inquiries regarding admission decisions.

## 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 the 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 being affected by natural disasters.
- (c) If admission fees and tuition fees are revised by the University, the students are required to pay the revised amount.
- (d) Students who will graduate from the master's course of Osaka University and subsequently wish to continue their studies by advancing to the doctoral course have no obligation to pay the admission fee.

## **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**

- (1) If any of the application documents include false information, the applicant's admission will be cancelled even after he/she has enrolled.
- (2) If those applicants who have applied with an official document certifying the expected date of the applicant's graduation but cannot graduate by the day before the date of admission to Osaka University, the applicant's admission will be cancelled.
- (3) On condition that visa acquisition and enrollment procedures proceed without any problems, applicants must make every effort to arrive in Japan before the date of enrollment and start the course on the date of enrollment.
- (4) Applicants are recommended to become well acquainted with the Japanese language, culture, customs, and so on. Knowledge of the Japanese language will prove to be useful during your stay in Japan.

## **12. Special Note for Tuition Fee Exemption for International Honors Students**

Osaka University has a tuition fee exemption system (Tuition Fee Exemption for International Honors Students) for privately-funded international students who are of excellent academic standing in the graduate school entrance examinations. This entrance examination is subject to the Tuition Fee Exemption for International Honors Students. Those who have passed this entrance exam and are recognized as being exceptionally outstanding will qualify for the tuition fee exemption under this system. Please note that this system does not include admission fee exemption. For details, please refer to the Appendix found at the end of the guideline.

## **13. Contact information for inquiries**

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

## 2024 Tuition Fee Exemption and $\Sigma$ Scholarship / Special $\Sigma$ Scholarship for International Honors Students

### 1. Outline

Osaka University provides a tuition fee exemption system (Tuition Fee Exemption for International Honors Students) for privately-funded international students who are of excellent academic standing in the graduate school entrance examinations. This entrance examination is subject to the Tuition Fee Exemption for International Honors Students. Those who have passed this entrance exam and are recognized as being exceptionally outstanding will qualify for the tuition fee exemption under this system. Please note that this system does not include admission fee exemption.

### 2. Number of openings

A small number of openings for master's and doctoral course respectively

### 3. Amount to be exempted

535,800 JPY per year (Osaka University tuition) as the standard term(\*) of study of the course

(\*) Three (3) years for doctoral course, two (2) years for master's course

Note: The period of a leave of absence shall be included in the exemption period and the exemption period shall not be extended after re-enrollment. Students who have been enrolled longer than the standard period of study from their enrollment in the program/course will become ineligible for the exemption.

### 4. Qualifications for applying

1. Those who have applied for the Special Program "Engineering Science 21st Century" and who have passed the entrance exam with exceptionally outstanding results.
2. Those who have a GPA of 3.2 or higher at the bachelor's level for those who have passed the master's course exam, and those who have a GPA of 3.2 or higher at the master's level for those who have passed the doctoral course exam.
3. Those who do not receive support equivalent to tuition fees from the Japanese government, foreign governments, private scholarship foundations, etc.

### 5. How to apply

In the designated section of the application form for the Special Program "Engineering Science 21st Century" for admission in April or October 2024, state your intention to apply for this abovementioned tuition fee exemption system and submit the required documents at the time of application for the entrance examination.

[Required documents]

- a) a document which shows a GPA of 3.2 or higher in the most recent course of study
- b) a letter of recommendation from your current or previous academic supervisor (free form)
- c) self-introductory document (free form, 3 pages)

### 6. Screening

Selection will be made based on the results of the entrance examination and the documents mentioned above.

### 7. Notification of the results

Results will be announced at the same time as the notification of the entrance examination.

## 8. Suspension of Tuition Fee Exemption

Tuition fee exemption will be revoked in the following cases:

- The student arrives in Japan without obtaining a "Student" status of residence or in the case that the status of residence of "Student" is changed to another status of residence.
- It is confirmed that completion within the standard period of study is not possible.
- The student has been subjected to disciplinary action such as suspension in accordance with the university rules and regulations.
- The student has received a tuition fee waiver under another system
- The university determines that exemption under this system is not suitable due to academic performance, etc.

## 9. Note

Students who receive tuition fee exemption under this system should not apply for another tuition fee exemption under other systems that support students who have difficulty paying fees due to financial difficulties.

## 10. $\Sigma$ Scholarship for doctoral course students

Accepted doctoral students will be eligible to apply for the  $\Sigma$  Scholarship (500,000 JPY per year) if they meet the requirements. Notification of details will be made through your academic supervisor after admission.

## 11. Special $\Sigma$ Scholarship

Those who are selected for this system and achieve exceptionally outstanding results in the screening examination will be eligible to receive the Special  $\Sigma$  Scholarship, which is equivalent to the entrance fee (282,000 JPY). The Special  $\Sigma$  Scholarship will be awarded to students after they are admitted to the Graduate School of Engineering Science.

## Department of Materials Engineering Science

| Division                          | Area                                   | Research Group  | Keywords  | Professor                                       |
|-----------------------------------|--|---|---|---|
| <b>Materials Physics</b>          | Electron Correlation Physics           | Theory Group for Strongly Correlated Systems                                    | Topological insulators and superconductors, Exotic superconductors, Strongly correlated electron systems, Quantum magnetism, Quantum criticality, Mathematical physics  | Prof. FUJIMOTO Satoshi                          |
|                                   |  | Experimental Group for Spectroscopy of Correlated Materials                     | Bulk-sensitive photoelectron spectroscopy (hard X-ray and extremely low-energy excitation), High-energy electron spectroscopy and their dichroism, Strongly correlated electron systems   | Prof. SEKIYAMA Akira                            |
|                                   |  | Experimental Group for Quantum Physics of Strongly Correlated Systems           | 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. YAMAMOTO Takashi                          |
|                                   |  | Group for Emergent Functional Material Science                                  | Exploration of quantum materials (strongly correlated and topological materials), thermoelectrics, superconductivity, quantum transport phenomena, high-pressure synthesis, computational science   | Prof. ISHIWATA Shintaro                         |
|                                   |  | 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. CHIBA Daichi                              |
|                                   |  | Theoretical Nanotechnology  | Computational materials science, Ab-initio calculation, Surface and interface physics, Amorphous, Machine-learning potential, Topological data analysis   | Prof. MINAMITANI Emi                            |
| <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   |   |
|                                   |  | 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, Interfaces of Electrochemical Devices, Operando measurement, Nano Science, Electrode Interfaces, Ionic Liquid Interfacial Chemistry, Catalytic Reaction Mechanism  | 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<br>*Retiring in March 2025 |
|                                   | 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 chemistry, Quantum functional materials, Open-shell systems, Optical and magnetic properties, quantum transportation, quantum nonlinear optics, quantum dynamics  |   |
|                                   |  | 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, polymer upcycle, biomass refinery  | 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<br>*Retiring in March 2025 |
|                                   |  | 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, Bioseparation, Drug Delivery System (DDS), RNA, Protein, Biomembrane  | Prof. UMAKOSHI Hiroshi                          |
|                                   |  | Biochemical Materials Engineering Group   | Biomedical, Biomaterial, Tissue fabrication, Hydrogel, Soft matter, Biochemical engineering   | Prof. SAKAI Shinji                              |
|                                   | Solar Energy Chemistry                 | Energy and Photochemical Engineering Group                                      | Photocatalysts, 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                             |
|                                   |  | Correlated Molecular Functions Group  | Synthesis of Novel Materials, Organic Radicals, Transition Metal Complexes, Metal Nanoclusters, Structural Analysis, Correlated Electric-Magnetic-Photonic Functions, Electronic Structures, Asymmetric Catalytic Reactions, Homogeneous Catalytic Reactions                          | Prof. KUSAMOTO Tetsuro                          |
|                                   |  | Theoretical Group for Photophysics in Nanomaterials                             | Microscopic theory of light-matter interaction, Photo-functional design with nano-materials, Optical manipulation of nanostructures, Theory of nonlinear optical response of solids   | Prof. ISHIHARA Hajime                           |
|                                   | 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                             |   |
|                                   | 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            | Nanomechanics and Physics Group                 | Strength of Materials, Theory of dislocations, Plasticity, Ceramics, Semiconductor, Ferroelectrics, Transmission Electron Microscopy, Scanning Probe Microscopy, Nanoindentation, Photoplastic effect, Multiphysics, Hydrogen embrittlement of metals, Hydrogen energy materials   | Prof. NAKAMURA Atsutomo      |
|                               |   | Solid Mechanics Group                           | Mechanics of flexible materials and structures, Finite element method, Isogeometric analysis, Theory of elasticity, Differential geometry, Origami-Kirigami-Amigami, Computer simulation, Digital twin, biomimetics  | 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, Machine learning, 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            |
|                               |   | Neuromechanics Group                            | Dynamics and control of human movement, Animal locomotion, Modeling and simulation of neuro-musculo-skeletal system, Dynamical systems theory and computational neuroscience, Dynamics and control of legged robots, Healthcare system   | Prof. AOI Shinya             |
|                               |   | BioMedical Engineering Group                    | Medical Device, Artificial Organs, Biosensing, Bioinformation Monitoring, Biomaterials, Medical Imaging  | Guest Prof. TSUKIYA Tomonori |
|                               | Biophysical Engineering                 | Bio-Dynamics Group                              | Human motor control, Human motor learning, Posture and Gait, Computational Neuroscience, Neuro-mechanics, Biomedical Engineering, 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                  | Biophysical and molecular mechanisms of cell homeostasis and resulting adaptation to mechanical environment, Cell mechanobiology, Soft matter physics, Numerical study-based design of microrobots and its relevance to microorganisms   | Prof. DEGUCHI Shinji         |
|                               |   | Bioimaging Group                                | BME, Medical Image, Smart Sensing, Presentation Systems, Multipurpose Displays, VR/AR, Computer Vision, SLAM, Image Measurement, Sensory Information Processing, Mechatronics, Functional Material, Digital Fabrication, Soft Robotics, 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 / materials, Thermoelectric conversion, Thin film thermoelectric generation, Phonon engineering, Group-IV semiconductor, Transparent oxide materials, Molecular beam epitaxy  | Prof. NAKAMURA Yoshiaki                        |
|   |   | Nano-scale Physics & Device Group                          | Semiconductor spintronics, Spin-MOSFET, Molecular beam epitaxy (MBE), Heusler alloys, Interfacial multiferroic devices, superconducting devices   | 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                  | No applications this year   |  |
|   | Optical Electronics                           | Microwave Photonics Group                                  | Transformation optics, Metamaterials, Topological photonics, Photonics crystals, Plasmonic devices, Microwaves, Millimeter-waves, Terahertz waves, Wireless communications, Electromagnetic sensing   | Prof. SANADA Atsushi                           |
|   |   | Information Photonics Group                                | No applications this year   |  |
|   |   | Quantum Electronics Group                                  | No applications this year   |  |
|   | 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                                    | No applications this year   |  |
|   |   | Systems Analysis Group                                     | Signals and Systems Analysis, Adaptive System, Speech Intelligibility, Active Noise Cancellation, Image Understanding and Restoration, Feature Extraction and Classification, Sparse Signal Processing  | Prof. IIGUNI Youji<br>*Retiring in March 2025" |
|   | 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                                  | Augmented/Mixed Reality, Virtual Reality, Human Augmentation, Digital Fabrication, Human Interface, Image Sensing, Visual Media, Intelligent Sensing, Digital Archives  | Prof. SATO Kosuke                              |
|   |   | Robotic Manipulation Research Group                        | Robot Manipulator, Robotic Hand, Motion Planning, Motion Analysis, Assembly, Machine Learning, Industrial Robot, Humanoid Robot   | 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, Analytic basis of neural nets   | 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, Machine learning, selective inference, functional data analysis, fMRI data analysis, Cluster analysis, Visualization   | Prof. KANO Yutaka<br>*Retiring in March 2024   |
| <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, Statistical Seismology, Survival Analysis, Mathematical statistics   | Prof. UCHIDA Masayuki                          |
|   |   | Research Group of Mathematical Modeling in Finance         | Dynamic utility maximization, Stochastic optimal control, Dynamic programming equation, Insurance mathematics, Quantitative risk management, Mathematical Finance   | Prof. SEKINE Jun                               |
|   |   | Research Group of Stochastic Analysis                      | Stochastic integration, Stochastic (partial) differential equations, Fractional Brownian motion, Rough path analysis, (Quantum) Computational Finance, Stochastic numerical analysis, Asymptotic distribution theory  | Prof. FUKASAWA Masaaki                         |
|   |   | Research Group of Stochastic Processes                     | Stochastic processes, Brownian motion, Diffusion processes, Levy processes, Martingales, Limit theorems, Arc-sine law, Excursion theory, Penalisation problems  | Prof. YANO Yuko                                |
|   | Theoretical Systems Science                   | Research Group of Complex Systems                          | Geometric deep learning, Scientific machine learning, Trustworthy AI, Network security, Self-organizing control, Blockchain   |  |
|   |   | Research Group of Systems Optimization and Decision Making | Decision making, Systems optimization, Multiple criteria decision aiding, Fuzzy logic, Distributed optimization, Collaborative control. Soft Computing, Multi-agent system, Data mining   | Prof. INUIGUCHI Masahiro                       |

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

## Master’s and Doctoral Courses in English

### Contents of Study

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(○)    |
| Advanced magnetism and spintronics                                  | 2(○)    |
| Properties of Materials   | 2(○)    |
| Bio-Inspired Chemical Engineering 1                                 | 1(○)    |
| Bio-Inspired Chemical Engineering 2                                 | 1(○)    |
| Molecular Nanotechnology  | 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(*)    |

| Lectures                                    | Credits |
|---|---------|
| Medical Virtual Reality                     | 2(*)    |
| Advanced Optoelectronics                    | 2(o)    |
| Adaptive Robotics                           | 2(*)    |
| Signal Analysis Theory                      | 2(*)    |
| Theory of Systems Analysis                  | 2(*)    |
| Applied Robotics                            | 2(*)    |
| Intelligent Robotics                        | 2(*)    |
| Mixed Reality Systems                       | 2(*)    |
| Imaging Systems                             | 2(*)    |
| Database Systems                            | 2(*)    |
| Communication Robot                         | 2(*)    |
| Intelligent Learning System                 | 2(*)    |
| Mathematical Cognitive Systems              | 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(*)    |
| Nonlinear System Theory                     | 2(o)    |
| Systems Optimization and Analysis           | 2(*)    |
| Intelligent Mathematical Programming System | 2(*)    |
| Introduction to Engineering Science         | 2(o)    |
| Advanced Physical Chemistry                 | 2(o)    |
| Advanced Organic Chemistry                  | 2(o)    |
| Advanced Chemistry for Material Science     | 2(*)    |
| Chemical Reaction Engineering               | 2(*)    |
| Biochemical Materials Engineering           | 2(*)    |
| Solid State Devices                         | 2(o)    |
| Opto- and Quantum Electronics               | 2(o)    |
| Advanced Mathematical Science A             | 2(o)    |
| Advanced Mathematical Science B             | 2(o)    |
| Advanced Mathematical Science C             | 2(o)    |
| Engineering Science Research Internship 1   | 1(o)    |
| Engineering Science Research Internship 2   | 2(o)    |

# Graduate School of Engineering Science

## OSAKA UNIVERSITY

### 1. Message from the Dean

Aiming for further development of the School/ Graduate School of Engineering Science

The School/ Graduate School of Engineering Science has a unique philosophy of “Fundamentally developing scientific technology by a fusion of science and engineering will create the true culture of humanity.” Based on this philosophy, we have always pioneered new academic fields. In other words, our motivation comes from the desire to develop education and research from the pursuit of the scientific principles, which is the basis of engineering, to their systematization and application to technological development, as well as interdisciplinary fusion. In addition, we have nurtured human resources with both scientific and engineering perspectives and have contributed to the development of modern society supported by the progress of science and technology.

“Engineering Science,” which is the core name of our faculty and graduate school, is different from “Science and Engineering.” It means not only deepening basic scientific principles but also fusing both science and engineering to create new research fields. We have extended this interdisciplinary fusion to the fields, such as life sciences, medicine, information sciences, humanities and social sciences, other than engineering and science. Sixty years after the faculty was founded in 1961, that effort flourished. Interdisciplinary fusion has come to be recognized as indispensable for the innovation of advanced science and technology and the solution of complex and diversifying social issues on a global scale. Therefore, expectations are rising for Engineering Science that enables deepening of scientific principles and interdisciplinary fusion. Currently, our graduate school is promoting original interdisciplinary research that will bring about future social changes. It includes the following: Material Creation, which fuses physics and chemistry; Spintronics, which brings about innovation of electronic devices; Quantum Computing, which leads to the next-generation computational science; Robotics, which aims for a symbiotic society of humans and intelligent systems; Bioengineering, which supports medical care and welfare; and Mathematical Data Science, which is the basis of utilizing information. These interdisciplinary studies also play a leading role in Osaka University, which has been certified as a designated national university aiming to create innovation.

Our Engineering Science consists of a faculty consisting of 10 courses in 4 departments, a graduate school consisting of 11 courses in 3 departments, and 5 affiliated research centers. Its strength lies in our educational foundation based on mathematics and information, physics, chemistry and biology as a background; furthermore, its organizational strength to create new interdisciplinary fusion fields by connecting research organizations covering various specialized fields, with research in different disciplines, and in an organizational culture that is not aware of the barriers between fields. As a result, unlike integrated education and research that simply combines advanced research fields, the knowledge gained through fusion is returned to basic and applied research in the specialized fields here, which deepens and creates new academic fields. Flexible thinking that is not bound by established academic fields is reflected in undergraduate and graduate education, and education for working adults. Engineering Science’s education and research system has achieved cyclical development in this way, and has been built under the unchanging philosophy for more than half a century. We would like to continue to maintain this tradition and further to develop Engineering Science with the philosophy of creating the true culture of humanity by incorporating advanced research, scientific technology, and the needs of society that are advancing with the times.

Dean

Graduate School of Engineering Science,  
Osaka University



## 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 interdisciplinary 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

School/Graduate School of Engineering Science

Established in

1961 — Department of Mechanical Engineering

Department of Chemistry

Department of Electrical Engineering

Common Chairs (Mathematical Science)

1962 — Department of Control Engineering

Department of Material Physics

1963 — Department of Chemical Engineering

1964 — Graduate School of Engineering Science

Mathematical Science Course

Physical Science Course

Chemical Science Course

1967 — Department of Biophysical Engineering

1970 — Department of Information and Computer Sciences

1992 — Department of Systems Engineering  
(reorganized from Department of Control Engineering)

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:

Department of Chemical Science and Engineering

Department of Informatics and Mathematical Science

1997 — Department of Electronics and Materials Physics

(reorganized from Department of Electrical

Engineering and Department of Material Physics)

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

2002 — Graduate School of Information Science and Technology

Graduate School of Frontier Bioscience

2003 — Graduate School was reorganized as follows

Department of Materials Engineering Science

Department of Mechanical Science and Bioengineering

Department of Systems Innovation

2014 — Center for Science and Technology under Extreme Conditions

Center for Promotion of Advanced Interdisciplinary Research

2016 — Center for Spintronics Research Network

2017 — Center for Industry-University Collaboration

2021 — Research Center for Solar Energy Chemistry



## Special Program of “Engineering Science 21<sup>st</sup> Century” In English Graduate School of Engineering Science, Osaka University

