Master's Program in Engineering Sciences

Master of Engineering

Program Educational Objectives

In the diverse areas of engineering which range from substances, materials, devices to measurement technologies, the Master's Program in Engineering Sciences is designed to cultivate highly specialized professionals who base themselves on their sufficient fundamental abilities in science and have the applied engineering ability and the ability to make use of it to address diverse problems in reality using supple flexibility, create original technologies and cultivate potential younger talents.

Graduate Profile	In the diverse areas of engineering which range from substances, materials, devices to measurement technologies, the Program helps students develop sufficient fundamental abilities in science and cultivates highly specialized professionals who possess the high research and development ability to contribute to the society through the Program's education and research activities by way of a system of multiple supervisory faculty members with a wide variety of values. <Subprogram in Applied Physics> Highly specialized professionals with advanced specialized knowledge and abilities who lead research, technological development and engineering practice at the world's level in the areas of applied instrumentation, nanotechnology and electronic devices founded on the natural science around physics <Subprogram in Materials Science> Highly specialized professionals who possess the deep knowledge in the areas of expertise in materials engineering such as quantum physics of solid state, theoretical quantum physics, materials physics, and materials chemistry and biomaterials engineering and can contribute to the society through advanced research ability

Diploma Policy

The degree of Master of Engineering is commenced to those who have fulfilled the requirements for the completion of the Master's programs, as set out in the Graduate School Regulations of the University of Tsukuba and related university regulations, and who are deemed to have the following competences.

	Competences	Evaluation perspectives
Knowledge and Skills	1. Knowledge application competence: Ability to contribute to society with advanced knowledge	①Can you apply knowledge gained through research and other activities in society? ②Can you identify new problems, even in other fields of expertise, based on broad knowledge?
	2. Management competence: Ability to appropriately address challenges from broad standpoints	①Can you take on major tasks with systematic planning? ②Can you understand and solve problems from multiple perspectives?
	3. Communication competence: Ability to accurately and clearly communicate expert knowledge	①Are you capable of efficient communication for research purposes? ②Can you discuss research or research-specific knowledge with experts from your own field and from other fields?
	4. Teamwork competence: Ability to work with a team and actively contribute to the achievement of goals	①Do you have experience cooperatively and actively working on challenges as part of a team? ②Have you helped promote projects and activities other than your own research?
	5. Internationality competence: Willingness to contribute to international society	①Are you aware of making contributions to international society and getting involved in international activities? ②Have you obtained the linguistic skills necessary for international information collection and action?
	6. Fundamental engineering ability: Basic knowledge and academic abilities appropriate to highly specialized professionals in the areas of engineering	If one has interests in global trends in the areas of engineering and if knowledge was gained
	7. Basic academic abilities indispensable for the comprehension in the areas of engineering	If mathematical knowledge and abilities widely used in engineering were gained
	8. Specialized knowledge: Basic knowledge required for the comprehension in the areas in engineering	If one has interests in research trends in the areas of engineering and if specialized knowledge was widely gained

<table>
<tr><td rowspan="3">Knowledge and Skills</td><td>Competences</td><td>Evaluation perspectives</td></tr>
<tr><td>9. Ethical view: Ethical view required of highly specialized professionals in the areas of engineering</td><td>If researcher ethics, engineer ethics, and human research ethics as well as formalities and/or procedures necessary for research were sufficiently understood</td></tr>
<tr><td>10. Insight and problem-solving ability required to solve problems in practice in the areas of engineering</td><td>If papers or other materials in English in the areas of engineering are understood and research is carried out with the accomplishment of significant results</td></tr>
<tr><td>Guidelines for Assessing Learning Outcomes</td><td colspan="2"><Subprogram in Applied Physics>
Learning outcomes are evaluated by objectively confirming and evaluating them using the "Achievement Evaluation Table (Rubric)". After the Master's Thesis Review, the final examination will be conducted via oral questioning as outlined below.
– During the final examination, oral questioning will be conducted regarding the purpose, methodology, and progress of the research in the Master's Thesis (Research in Applied Physics). This will confirm whether the candidate possesses knowledge application skills, management skills, communication skills, and teamwork skills.
– The final examination includes an oral examination in a foreign language to confirm the candidate's ability to provide appropriate responses.
– The final examination includes oral examinations on fundamental engineering skills, basic academic skills, and specialized knowledge to evaluate the candidate's ability to provide appropriate responses.
– The final examination includes an examination on research ethics to confirm the candidate's thorough understanding.
– During the final examination, oral questioning on engineering field problems will be conducted to confirm the candidate's ability to provide appropriate responses.

<Subprogram in Materials Science>
The evaluation of learning outcomes is conducted using an Achievement Evaluation Sheet, which serves as a rubric to systematically assess the level of competence acquisition in accordance with the diploma policy at each stage of the program.
During the first and second years, presentations given in the Master's Seminar are evaluated by the primary advisor and several faculty members to assess the extent to which students have acquired the required competences. At the end of the first year's fall semester, students present an interim report on their thesis research, which is followed by self-assessment, formal review, and guidance provided by the faculty. Finally, at the end of the second year, a public presentation of the completed master's thesis is held, and a Thesis Examination Committee, consisting of the primary advisor and at least two sub-examiners, conducts a comprehensive review of the thesis research. This process also includes a final achievement assessment, which serves as the final examination for completion of the program.</td></tr>
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Evaluation Criteria for Degree Theses/ Dissertations	【Review board members】 Set up with one chief reviewer and two or more sub-reviewers. 【Review method】 Thesis review and the final exam are administered in accordance with the method defined by each Subprogram. 1) Subprogram in Applied Physics The thesis review board administers thesis review and final exam. 2) Subprogram in Materials Science The thesis review board administers thesis review and final exam to evaluate if the student possesses the academic abilities and knowledge that become the foundations of all areas of materials engineering and the specialized knowledge of any of the areas of materials engineering and has successfully carried out research with a required level of results along with a specific theme in any of the areas of materials engineering. 【Review items】 1. The setup of research tasks and the selection of research methods must be appropriate. 2. The interpretation of results and the development of line of reasoning before reaching the conclusion must be appropriate and unequivocal. 3. The preceding researches related to research tasks must be grasped and understood with appropriate appraisal and citation. 4. With adherence to research ethics, the obtained results and conclusions must be verifiable by third parties. 5. Academic significance must be identifiable in the outcomes of research tasks. 【Level standards required for the degree thesis】 All of the above evaluation items and the criteria defined by each Subprogram must be met. 1) Subprogram in Applied Physics The thesis passes as a master's thesis with the final exam included in the judgment. 2) Subprogram in Materials Science The curriculum objectives defined in article 2, clause 3 of the school rules of Graduate Education at University of Tsukuba must be fulfilled. With this fulfillment, the thesis passes as a master's thesis with the final exam included in the judgment.

Curriculum Policy

The curriculum is organized with Foundation Subjects for Major, Major Subjects, laboratory seminars, etc., graduate school seminars, and research activities for the areas founded on the natural science around physics, which are the areas of applied instrumentation, nanotechnology and electronic devices, and the areas of expertise in materials engineering such as quantum physics of solid state, theoretical quantum physics, materials physics, and materials chemistry and biomaterials engineering.
The Program is designed to provide students with education and research supervision to develop a breadth of basic skills in pure and applied sciences and to have the big picture in mind in science and technology, which extends over natural science and engineering, as well as the generic knowledge and ability that support students to be active in diverse social scenes, along with the research ability, specialized knowledge and ethics in each area of expertise.

Curriculum Design Framework	In order to cultivate the basic skills and wide perspectives as well as generic knowledge and ability in associated areas with the student's major at the core, Colloquium on Pure and Applied Sciences (1 credit) must be taken as a required subject from Degree Programs' Common Courses, and students are encouraged to take other Degree Programs' Common Courses, Inter-disciplinary Foundation Courses and Graduate General Education Courses. The research supervision takes a multiple-instruction scheme to develop a research ability that exerts multifaceted perspectives. – Foundation Subjects for Major are organized with Common Foundation Subjects on a Subprogram basis so that the base subjects, which serve as the foundation of the areas of technology now and in the future, are expanded from the College level. – With Major Subjects, students gain deep specialized knowledge in specific areas in Subprograms. <Subprogram in Applied Physics> – Students take Major Subjects for the specialized disciplines commonly required in each area of specialty. In the seminar of each laboratory, which permits the participation of other laboratories' students, more specialized contents are learned. – In graduate school seminars, students make presentations about the outcomes of daily routine research activities. In this setting, students cultivate their logic forming skill, communication skill and communication ability. <Subprogram in Materials Science> – The Subprogram is composed of the four areas of “quantum physics of solid state”, “theoretical quantum physics”, “materials physics” and “materials chemistry and biomaterials”. Each area's “Research IA, IB, IIA, IIB” (a total of 12 credits) are required subjects. In these subjects, in addition to the research activities according to each student's theme for master's thesis creation, students are required to make a research presentation once a year in “Master's Program Seminar”, in which the students and faculty members in the major participate. – By this, students understand the significance, outcomes and position of the research theme that each one has respectively worked on and gain the presentation and communication abilities of explaining using their own words.

Curriculum Design Framework	– Basic academic abilities and the deep specialized knowledge in specific areas are gained with Foundation Subjects for Major and Major Subjects. – A wide perspective is acquired with specialized subjects of other Programs or other Courses, and Graduate General Education Courses.
Teaching and Learning Methods	– In the Subprogram in Applied Physics, students take Biological and Medical Engineering and Material and Device Physics for Nanoscience in addition to Quantum Mechanics, Statistical Mechanics, Electromagnetism and Solid State Physics, which are common Foundation Subjects for Major, so that the base subjects, which serve as the foundations of these areas now and in the future, can be expanded from the College level. In the Subprogram in Materials Science, students take “Materials Chemistry” and “Chemical Biology” so that the base subjects serving as the foundations of the four areas of “quantum physics of solid state”, “theoretical quantum physics” , “materials physics” and “materials chemistry and biomaterials” can be expanded from the College level. – For the details on Major Subjects, see below. <Subprogram in Applied Physics> – With Major Subjects (Introductory Sciences in Advanced Surface Measurements, Charged Particle and Plasma Engineering Science, Advanced Instrumentation I, Device Engineering, etc.), students learn for the specialized disciplines commonly required in each area of specialty. – Through the research activities and seminar presentations in Research IA, etc. in the area, students gain the fundamental abilities indispensable for the understanding and expansion of the advanced areas of specialty, as well as the highly specialized fundamental abilities required of the area's researchers or highly specialized professionals, practical insight and ability to act, wide perspective, problem-solving ability, and the presentation and communication abilities to debate with experts in the world. <Subprogram in Materials Science> – With Major Subjects (Introduction to Optical Properties of Solids, Group Theory in Molecules and Solids, Metallic Functional Materials, Polymer Chemistry, Energy Materials and Environmental Materials, Biomaterials, etc.), students seek to gain the specialized knowledge universally required in the area. – Through the research activities and seminar presentations in Research IA, etc. in the area, students acquire the abilities required of highly specialized professionals, such as highly specialized fundamental abilities, practical ability, broad perspective, problem-solving ability and information provision ability.

Admission Policy

Desired Student Profile	We seek students who have the motivation to expand their learning in this area with their robust basic academic abilities and English proficiency necessary for learning advanced engineering, as well as extensive and deep curiosity, mental capability that spares no effort to make their purposes, high ethical view, robust disciplinary bases and sufficient communication ability.

Student Selection Process	The base parameters for the selection of candidates are basic academic abilities and basic knowledge as well as the deep insight based on them. Those who have the motivation and concentration for carrying out research proactively and enthusiastically are selected through written and oral exams.

Learning Support Framework

Academic Support	<Subprogram in Applied Physics> – A multiple-advisor system ensures objectivity in research guidance and facilitates diverse consultation support. – A required graduate seminar is offered for first- and second-year master's students. This provides an opportunity to present one's own research and listen to others' presentations, enabling objective review of one's research and supporting its deepening. <Subprogram in Materials Science> Through a system of multiple academic advisors, the program ensures the objectivity of research supervision and provides a structure that allows students to seek advice on a wide range of issues. Opportunities are provided for students to participate in research presentation meetings, with travel expenses covered to encourage their involvement. These events serve as valuable opportunities for students to objectively review their own research approaches and to further advance their studies. Intensive courses are also offered to help students improve their skills in academic writing and delivering presentations in English. In addition, to broaden their perspectives, the program organizes Materials Engineering Seminars, inviting speakers from both inside and outside the university to share their expertise and insights.

Opportunities for Peer Interaction	<Subprogram in Applied Physics> – We offer a required graduate seminar for first- and second-year master's students. This seminar incorporates a mechanism into the curriculum that promotes exchange opportunities among students across grades and organizations. Students present their own research, listen to others' presentations, and engage in Q&A sessions. – We have created a system that continuously generates opportunities for peer learning through teaching assistantships (TAs) for undergraduate lectures and experiments. – Through student gatherings held at the Graduate School, opportunities for interaction among students across disciplines are provided. <Subprogram in Materials Science> The program provides opportunities for students to participate in research presentation meetings beyond their own academic year, integrating these activities into the curriculum to promote interaction among students across different cohorts through Q&A sessions and discussions. In addition, it fosters continuous peer learning by implementing a Teaching Assistant (TA) and tutor system, as well as supporting student-led projects. Furthermore, the program encourages participation in student gatherings organized by academic institutes and research centers, providing opportunities for students to engage with peers from diverse academic disciplines.
Opportunities for Student–Faculty Interaction	<Subprogram in Applied Physics> – Through student gatherings held at the Graduate School, opportunities for interaction among students across disciplines are provided. – In the graduate seminars, students present and engage in Q&A sessions not only with their primary and secondary advisors but also in front of other faculty members, providing opportunities for interaction with faculty beyond their direct advisors. – An annual graduate student-faculty discussion meeting is held to promote interaction between students and faculty. <Subprogram in Materials Science> The program provides opportunities for students to engage with faculty members from various fields beyond their own area of specialization through gatherings organized by academic institutes and research centers. In addition, all faculty members involved in the degree program participate in events such as the master's thesis presentation meeting, creating opportunities for interaction and exchange of ideas between students and both their primary advisors and other faculty members. Furthermore, an annual meeting is held to facilitate open discussions and strengthen communication between students and faculty.

Approaches to Assuring and Enhancing Educational Quality

<Subprogram in Applied Physics>

- Questionnaires are conducted after lectures (specialized subjects, specialized foundation subjects, etc.) to inform verification and improvement.
- Syllabus checks are conducted annually, primarily by academic affairs committee members. Quality is ensured by prompting faculty to make revisions or improvements as necessary.
- After the master thesis examination, evaluate the students' learning outcomes and verify the validity of the curriculum and the appropriateness of guidance.

<Subprogram in Materials Science>

By having all faculty members participate in the master's thesis presentation meeting, the program ensures that the quality of education is thoroughly reviewed. Any areas identified for improvement are then discussed by the program's steering committee, and necessary actions are taken to enhance the overall educational program.