Doctoral Program in Engineering Sciences

Name of the degree to be conferred	Doctor of Philosophy in Engineering
Educational purpose	In the diverse areas ranging from substances, materials, devices to measurement technologies, the Doctoral Program in Engineering Sciences is designed to cultivate outstanding researchers who base themselves on their sufficient fundamental abilities in science and possess the deep knowledge and rich creativity to address diverse problems in reality, as well as such researchers and highly specialized professionals who have the applied engineering ability and the ability to make use of it to create original technologies and cultivate potential younger talents.
Vision of human resources development	Outstanding researchers who base themselves on their sufficient fundamental abilities in science and possess the deep knowledge and rich creativity to address diverse problems in reality in leading-edge engineering, as well as highly specialized professionals who possess the advanced research and development ability to contribute to the society <Subprogram in Applied Physics> Human resources 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; researchers who possess outstanding research and development abilities with rich creativity or highly specialized professionals with advanced specialized knowledge and abilities <Subprogram in Materials Science> Human resources who possess the research ability necessary as an independent researcher with the deep knowledge in the areas of expertise in materials engineering such as quantum physics of solid state, theoretical quantum physics and materials physics, and materials chemistry and biomaterials engineering; researchers capable of carrying out advanced research and highly specialized professionals possessing the advanced research ability to contribute to the society <Subprogram in Materials Science and Engineering> Researchers of the National Institute for Materials Science supervise research as Graduate School faculty members to train human resources in the areas of materials engineering, such as metal and ceramic materials engineering, nanomaterials engineering, organic and biomaterials engineering, engineering physics, and semiconductor materials engineering; researchers who have very creative, outstanding abilities in research and development and highly specialized professionals who possess advanced applied engineering ability and the ability to make use of it to contribute to various social issues as experts of materials engineering.

Diploma Policy

The degree of Doctor of Philosophy in Engineering is commenced to those who have fulfilled the requirements for the completion of the Doctoral 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 competencies.

Competencies	Evaluation perspectives
1. Knowledge creation competence: Ability to create new knowledge that can contribute to future society	① Are there any research findings that can be considered new knowledge? ② Can we expect you to create knowledge that will contribute to future society?
2. Management competence: Ability to plan and implement measures to identify and solve challenges from a higher perspective	① Can you make and implement long-term plans for critical challenges? ② Can you identify challenges, even in other areas of expertise, and solve them from a higher perspective?

3. Communication competence: Ability to express the true nature of academic findings positively and clearly	① Can you explain the true nature of research content and specialized knowledge clearly and logically to researchers from different areas and to people other than researchers? ② Do you proactively share your findings with researchers and experts from your field of expertise and accurately answer questions?
4. Leadership competence: Ability to have objectives get accomplished under your leadership	① Can you set attractive and compelling goals? ② Are you capable of building systems to realize goals and accomplish objectives as the leader?
5. Internationality competence: Possession of a high level of awareness and motivation to be internationally active and contribute to international society	① Do you have strong awareness and motivation to contribute to international society and international activities? ② Have you obtained adequate linguistic skills for international information collection and action?
6. Fundamental engineering ability: Knowledge and academic abilities appropriate to researchers or highly specialized professionals in the areas of engineering	If a clear description of the nature of the research content and specialized knowledge is provided to the uninitiated or those from different areas and not just one's own area
7. Basic academic abilities: Solid basic academic abilities indispensable for applied studies in the areas of engineering	If advanced mathematical knowledge and abilities widely used in engineering were gained
8. Specialized knowledge: Advanced specialized knowledge required for applied studies in the areas of engineering and associated areas	If a wide range of specialized knowledge in the areas of engineering and the advanced techniques for conducting leading-edge research were gained
9. Ethical view: High ethical view required of researchers or highly specialized professionals in the areas of engineering	If researcher ethics, engineer ethics, and human research ethics as well as formalities and/or procedures necessary for research were sufficiently understood
10. Practical insight and problem-solving ability: Insight and problem-solving ability required to solve problems in practice in the areas of engineering and associated areas	① If leading-edge research tasks were appropriately set up and research was carried out with the accomplishment of ingenious results ② If the presentation and communication abilities to debate with experts in the world were gained

Dissertation evaluation criteria

【Review board members】

Structure of thesis review board

Set up with one chief reviewer and three or more sub-reviewers.

【Review method】

Preliminary review, thesis review and the final exam are administered in accordance with the method defined by each Subprogram.

1) Subprogram in Applied Physics

Prior to the receipt of a degree thesis, to determine the acceptance of the submission, the degree thesis is preliminarily reviewed.

The thesis review board administers thesis review and final exam.

2) Subprogram in Materials Science

Prior to the receipt of a degree thesis, to determine the acceptance of the submission, the degree thesis is preliminarily reviewed.

The dissertation review board does an evaluation to see 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 outstanding results while solving the tasks that he/she independently set out in any of the areas of materials engineering through the review of dissertation and the final exam or the confirmation of academic abilities.

3) Subprogram in Materials Science and Engineering

Prior to the receipt of a degree thesis, to determine the acceptance of the submission, the degree thesis is preliminarily reviewed. The thesis review board administers thesis review and final exam.

【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 internationally 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

Before a dissertation review board is opened, one first-author dissertation must be available to be published or posted in an academic journal.

The dissertation passes as a doctoral dissertation 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 dissertation passes as a doctoral dissertation with the final exam or the confirmation of academic abilities included in the judgment.

3) Subprogram in Materials Science and Engineering

A dissertation for degree grant meeting all of the above evaluation items passes as a doctoral dissertation with the final examination included in the judgment.

Curriculum Policy

The curriculum is designed to cultivate researchers and highly specialized professionals in the areas of applied instrumentation, nanotechnology and electronic devices, and the areas of quantum physics of solid state, theoretical quantum physics, materials physics, and materials chemistry and biomaterials engineering, etc., and the areas of materials engineering such as metal and ceramic materials engineering, nanomaterials engineering, organic and biomaterials engineering, engineering physics, and semiconductor materials engineering.

Curriculum organization policy	The curriculum is organized to help students gain specialized knowledge and abilities on the world's high level standards in the areas of engineering. <Subprogram in Applied Physics> ・Research is supervised from multifunctional points of view by way of a system of multiple supervisory faculty members. With this, the curriculum cultivates solid fundamental abilities and the deep specialized fundamental abilities founded on them and seeks to help students develop practical insight and the ability to act as well as the ability to solve problems. ・In the seminars opened for Research in Applied Physics, students are mandatorily required to make presentations to a wide variety of audiences from different areas and not just one's own area. For the presentations, students are encouraged to use English to develop the presentation and communication abilities that allow them to debate with experts in the world. ・With internship, overseas research dispatch, etc., students learn to develop a broad point of view and also the international insight to prepare them to be active worldwide.

	<Subprogram in Materials Science> ・The Subprogram is formed by the four areas of "quantum physics of solid state" , "theoretical quantum physics" , "materials physics" and "materials chemistry and biomaterials" . However, the subjects that students should take to complete the Subprogram are only the "Research IIIA, IIIB, IVA, IVB, VA and VB" (18 credits in total), which are the required subjects of each area. In these subjects, in addition to the research activities according to each student's theme for doctoral dissertation creation, students are required to make a research presentation once a year in "Doctoral Program Seminar" , in which the students and faculty members in the major participate, and use English in this presentation to be trained to present research progress and have debates in English. ・By this, students gain advanced specialized knowledge and the insight, problem-solving ability and communication ability required to actually solve problems. ・To gain a wide perspective not limited to the deep specialized knowledge in specific areas, students are encouraged to take Major Subjects in the Master's Program, specialized subjects of other Programs or Courses, and Graduate General Education Courses. <Subprogram in Materials Science and Engineering> ・Students learn under an international and intellectually stimulating research environment at a materials research institute. The curriculum is organized to develop specialized knowledge, basic knowledge in associated areas, the insight that enables students to draw up and set up research plans for new proofs of concept, skills of experimentally or theoretically carrying out drawn and set up research plans, high ethical view in research activities, and the English communication ability capable of internationally providing research outcomes through academia or paper presentations and capable of open and natural debates with overseas researchers. ・As subjects that should be taken to achieve this commitment, the curriculum offers "Research IA and IB" , "Research IIA and IIB" and "Research IIIA and IIIB" (18 credits in total), as well as "Seminar I" and "Seminar II" (2 credits in total). ・In "Research" which is pursued under a leading and international research environment, students are engaged in advanced research activities for doctoral dissertation creation. ・In "Seminar" , students are trained to present research progress and have debates in English. In addition, to gain a wide range of knowledge in the areas of engineering, students are encouraged to take the Master's Program subjects "Nanomaterials I" and "Nanomaterials II" in which faculty members provide discussion of their respective area of research.
Learning methods・Processes	Students take special research subjects to meet the fundamental abilities indispensable for the understanding and expansion of the advanced engineering areas of specialty and the necessity of organizing a degree dissertation containing the world's level outstanding research outcomes appropriate to a doctoral degree. <Subprogram in Applied Physics> ・Through "Research in Applied Physics IIIA, IIIB, IVA, IVB, VA and VB" , students gain the fundamental abilities indispensable for the understanding and expansion of the advanced areas of specialty in the areas of applied instrumentation, nanotechnology and electronic devices, as well as the highly specialized fundamental abilities required of these areas' 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> ・Through "Research IIIA, IIIB, IVA, IVB, VA and VB" in the four areas of "quantum physics of solid state" , "theoretical quantum physics" , "materials physics" and "materials chemistry and biomaterials" , students gain the abilities to set up tasks in their own right, then independently carry out research and understand the significance, outcomes and position of the research theme as well as the ability to provide information in English.

	<NIMS Subprogram in Materials Science and Engineering> ・In "Research in Materials Science and Engineering IA, IB, IIA, IIB, IIIA and IIIB" , students are engaged in the world's leading edge research and development in the areas of metal and ceramic materials engineering, nanomaterials engineering, organic and biomaterials engineering, engineering physics and semiconductor materials engineering, and thereby gain the high fundamental abilities and ethical view in research activities as well as the advanced specialized knowledge in the area, the skills to carry out research plans and the ability to solve tasks. ・In "Seminar in Materials Science and Engineering I and II" , students present their respective researches and have debates in English and thereby gain the ability to internationally present research outcomes and the communication ability.
Evaluation of learning outcomes	After the preliminary review process, the degree dissertation is submitted to a degree dissertation review board set up by four or more reviewers to be evaluated with examination and the final exam. <Subprogram in Applied Physics> ・Research is supervised and evaluated from multifunctional points of view by way of a system of multiple supervisory faculty members. ・The presentation for the graduate school seminar in Research in Applied Physics is fairly examined with numerical evaluation by all of the participating faculty members. ・In this, not only research and presentation qualities but also the abilities to respond to questions and ask questions are evaluated. ・Solid fundamental abilities and the outstanding specialized fundamental abilities founded on them, as well as the presentation and communication abilities and international insight are ensured. ・The review of degree dissertation along with preliminary review and the final exam are administered by the chief reviewer and three or more sub-reviewers, which include external experts as sub-reviewers. This evaluation includes an oral exam in addition to a written exam to ensure the satisfaction of the research level and dissertation quality on the worldwide standards and the objectiveness of evaluation. <Subprogram in Materials Science> ・The research activities that each student performs to create a doctoral dissertation with their respective themes as part of the required subjects "Research IIIA, IIIB, IVA, IVB, VA and VB" in each area take a system of supervision in which one student is supervised by chief supervisory and sub-supervisory faculty members as a total of two faculty members. In daily research supervision, these multiple faculty members evaluate the student to see the acquisition of the ability to independently set out tasks, carry out research and attain outcomes. ・Similarly, in the "Doctoral Program Seminar" as part of "Research IIIA, IIIB, IVA, IVB, VA and VB" , students are required to make a research presentation once a year so that the ability to independently explain the significance, findings and positions of the research theme, as defined in item ④ of Diploma Policy, is evaluated. ・As for the review of degree dissertation, the dissertation is preliminarily reviewed prior to its receipt to determine the acceptance of the submission. After accepted, the dissertation is evaluated by a dissertation review board set up with one chief reviewer and three or more sub-reviewers, which include faculty members who do not belong to this Subprogram or include external faculty members, etc. The review board does an evaluation to see 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 outstanding results while solving the tasks that he/she independently set out in any of the areas of materials engineering" through the review of dissertation, the final exam in the public review board, and the confirmation of academic abilities.

	For this evaluation, the following five items are examined: ① Appropriateness of research theme and dissertation subject ② Grasping of research background, position and ingenuity of research ③ Dissertation content (methods, results, conclusion), its academic and/or social significance, impact, contribution ④ Style of dissertation presentation, expressions, rational discussions, level of completeness (quality) ⑤ Adherence to research ethics. <NIMS Subprogram in Materials Science and Engineering> ・In Seminar in Materials Science and Engineering I and II in addition to Research in Materials Science and Engineering IA, IB, IIA, IIB, IIIA and IIIB, students are evaluated if they gained the ability to research from multifunctional points of view, fundamental abilities, specialized knowledge and the skills to carry out a research plan, together with the evaluation of achievements in research. ・Particularly, as part of the above subject, all students are mandatorily required to present their respective research content in English once a year. This presentation is evaluated from multifunctional points of view by all faculty members in the major to see the achievements in research and the presentation ability, including whether the research contains the specialized knowledge on a level appropriate to a doctorate and responds to social issues and whether the student exhibits the insight as an expert in the areas of materials engineering and the communication ability capable of having a debate in English. ・In the review of degree dissertation along with preliminary review, the doctoral dissertation content is evaluated by the chief reviewer and three or more sub-reviewers. To evaluate the dissertation from diverse perspectives, one or more faculty member who does not belong to this Subprogram participates as a sub-reviewer. In the final exam, an oral exam is publicly administered in addition to a written exam to ensure the satisfaction of the research level and dissertation quality on the worldwide standards and the objectiveness of evaluation.
Admission Policy	
Desired students	We seek candidates who have interests in engineering sciences, the robust disciplinary bases gained in the master's program, sufficient communication ability, extensive and deep curiosity, strong mental capability that spares no effort to make their purposes, high ethical view, deep long-range perspective, and outstanding foresight.
Selection policy	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 an oral exam based on the master's thesis content and the post-enrollment research plan.