Doctoral Program in Risk and Resilience Engineering

Doctor of Philosophy in Engineering

Program Educational Objectives

In these days of destabilized social conditions, one of the most important issues is to reach for secure and safe lands, districts, economy, and information society that have both “strength” and “flexibility” based on appropriate risk management, that is, a resilient system of society.
The Doctoral Program in Risk and Resilience Engineering seeks to cultivate academically global human resources who possess the research abilities, advanced skills and practical abilities based on deep theoretical foundations and the “ability to be flexible to unforeseen and changing circumstances from an engineering point of view, keep providing the required functionalities, and get them recovered”, which is in other words, the advanced skills that can put the results of risks analyzed and evaluated by engineering methods into use to reach for a resilient society and who can pass along the outcomes of education and research to the society with a view focused on actual social problems.

Graduate Profile	He or she should possess, based on the high fundamental engineering ability, the theoretical foundations and advanced associated information processing techniques for risk and resilience analysis and evaluation, and by adapting them from a wide comprehensive point of view to the real world's problems, which are the subject of risk and resilience engineering, he or she should be able to produce and develop concrete methods for identifying a problem and providing a solution using engineering means while fulfilling his or her given role shares in a research team or research project by bringing out high communication ability and taking a leadership position, and in addition can be active also in international scenes through their high presentation ability.

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 competences.

	Competences	Evaluation perspectives
Knowledge and Skills	1. Knowledge creation competence: Ability to create new knowledge that can contribute to future society	①Are there any research findings that can be considered new knowledge? ②Can 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	①Can you make and implement long-term plans for critical challenges? ②Can 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	①Can 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? ②Do 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	①Can you set attractive and compelling goals? ②Are 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	①Do you have strong awareness and motivation to contribute to international society and international activities? ②Have 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	①If a wide range of basic knowledge in the areas of risk and resilience engineering was gained ②If the high academic abilities as highly specialized professionals in the areas of risk and resilience engineering were gained ③ If academic outcomes were attained in the areas of risk and resilience engineering

	Competences	Evaluation perspectives
Knowledge and Skills	7. Knowledge of theoretical foundations and associated techniques: Knowledge of the theoretical foundations for risk and resilience analysis and evaluation based on the fundamental engineering ability, and associated advanced information processing techniques	①If the theoretical foundations for analyzing risks potential in complex phenomena and evaluating them from a resilience viewpoint were gained ②If the advanced information processing techniques for analyzing risks potential in complex phenomena and evaluating them from a resilience viewpoint were gained
	8. Knowledge about problems in reality: Deep knowledge about problems in reality that involve risk and resilience engineering	If the deep knowledge about the diverse problems in reality, to which risk and resilience engineering is applied, and the ability to evaluate research tasks in a variety realms were gained
	9. Ability to have the big picture in mind from a wide perspective: Ability to interpret, from a wide comprehensive perspective, the issues to which risk and resilience engineering is applied	If a wide and comprehensive perspective for interpreting the issues, to which risk and resilience engineering is applied, was gained
	10. Ability to identify and solve problems: Ability to deeply understand the process from identifying to solving a risk-resilience problem using engineering means and produce and develop the concrete means to provide a solution	①If problems are led to concrete solutions using an ingenious method with a view focused on actual social problems and with a wide understanding of the application of specialized skill——Ingenious solution process starting from problem identification ②If the skill of conducting a research project and rounding it up into research outcomes was gained ③If researcher ethics and engineer ethics were well understood and adhered by
	11. Global communication ability: Ability to fulfill one's given role shares, bring out high communication ability and take a leadership position in a research team or research project	①If the presentations about one's research and specialized knowledge are made with sufficient linguistic skill ②If capable of committing oneself to group research activities as an advisor and capable of promoting communication among students that include oneself while taking a leadership position

Guidelines for Assessing Learning Outcomes	The quality of education is assured with the following system of achievement evaluation. Achievements are evaluated for the following six achievement evaluation items. ①Fundamentals of engineering: Basic knowledge and academic skills of researchers or advanced professionals in engineering were gained ②Knowledge of basic theories and related skills: Knowledge of theoretical foundations for risk and resilience analysis and assessment based on fundamentals of engineering, and knowledge of advanced information processing technologies related to risk and resilience analysis and assessment were gained ③Knowledge of issues in the real world: In-depth knowledge of real-world issues covered by risk and resilience engineering was gained ④Broad perspective overlooking circumstance: Ability to see the subject of risk and resilience engineering from a broad and comprehensive perspective was gained ⑤Abilities of problem setting and solving: Ability to understand the process from setting up problems to solving them by engineering means in depth and to devise and develop specific solutions for problems related to risk and resilience were gained ⑥Global communication ability: Ability to fulfill assigned roles and take leadership in a research team or research project with high communication skills was gained Achievements are evaluated by the achievement evaluation board, which is administered with an interview between each student and three or more faculty members twice every academic year. The feedback on the evaluation results are given to students for the use of improving subsequent learning. The evaluation is conducted objectively using an Achievement Evaluation Form (rubric) to determine whether the student has reached a level appropriate for the Doctoral Degree in Engineering in all evaluation categories.

Evaluation Criteria for Degree Theses/ Dissertations	A thesis is accepted if all of the following evaluation items are proven to be met. <Criteria for degree thesis review> 1. The thesis must be the results of the research in which the diploma applicant took the initiative in accordance with research ethics. 2. The research must contain novelty. 3. The usefulness that contributes to make strides in risk and resilience engineering or associated areas must be contained. 4. The dissertation must be appropriately constructed and the content must be correct. (1) The theme of the thesis must be appropriate. (2) Preceding researches are accurately investigated and the positioning of the research must be fully discussed. (3) The purposes of research must be clearly and concretely described. (4) The methods of research must accord with the purposes and be clearly and concretely described. (5) The results must be accurately and clearly drawn and be assured in reliability. (6) Discussion must be logically developed based on results. (7) The conclusion must be clear and provide a description about social significance. (8) Citations must be appropriate. <Criteria for final exam> The evaluation is based on how the question-and-answer session goes for the explanation of the degree thesis and related matters and the results of achievement evaluation. <Level standards required for the degree thesis, review board members, review method and review items, etc.> The evaluation of degree thesis requires the approval of a degree dissertation review board formed by one chief reviewer and four or more sub-reviewers. The reviewers must be doctor's degree holders. The chief reviewer and two or more sub-reviewers must be faculty members of Degree Programs in Systems and Information Engineering. One or more sub-reviewers must be selected from those who do not belong to the Doctoral Program in Risk and Resilience Engineering. Opening a doctoral dissertation review board, the chief reviewer evaluates the dissertation in accordance with the criteria for degree dissertation review and judges the acceptance of the dissertation after having obtained approval of the board. The dissertation passes if approved to be on a doctoral dissertation level in all of the above evaluation items 1 to 4 with the final exam included in the judgment.

Curriculum Policy

To attain the Diploma Policy requirements, the curriculum is organized to cultivate students who possess the advanced skills that can put the results of risks analyzed and evaluated by engineering methods into use to reach for a resilient society, can pass along the outcomes of education and research to the society with a view focused on actual social problems, and possess the research abilities, advanced skills and practical abilities based on deep theoretical foundations.

Curriculum Design Framework	To attain the Diploma Policy requirements, the curriculum places emphasis on the two subjects of special seminars and special researches in the Doctoral Program. In addition, students take other specified lecture subjects to deepen the knowledge about problems in reality by more comprehensively integrating the perspective to the complex social problems that involve risks. Students attain the requirements enumerated in DP by incorporating the learning in these subjects and the research of each student's area of expertise into a doctoral dissertation.
Teaching and Learning Methods	The requirements enumerated in Diploma Policy are attained as follows. 1. “Fundamental engineering ability”, which is covered in almost all of the subjects, is gained through the subjects provided in the Degree Program. In addition, a wider range of learning is possible with Inter-disciplinary Foundation Courses. 2. “Theoretical foundations and associated techniques” which is covered in almost all of the subjects, is gained through the subjects provided in the Degree Program. Particularly, special researches in the Doctoral Program help students gain more deeply the theoretical foundations and information processing techniques for analyzing risks potential in complex phenomena and evaluating them from a resilience viewpoint. 3. “Problems in reality” which is covered in almost all of the subjects, is learned particularly through Major Subjects. Particularly, special seminars in the Doctoral Program, in which students learn and critically appraise research presentations in various realms to gain the knowledge about diverse problems in reality, help students gain this area of ability more deeply. 4. The abilities for “wide perspective”, which are covered in almost all of the subjects, are gained particularly through the subjects taught by faculty members in the Cooperative Graduate School System with companies, research institutes, etc. In addition, Topics in Risk and Resilience Engineering in Doctoral Programs of different areas of expertise and not just one's own area, and the internship subjects taught by faculty members in the Cooperative Graduate School System help students gain this area of ability more deeply.

Teaching and Learning Methods	5. The abilities to “identify and solve problems” are gained through Special Doctoral Research Work, in which each student carries out their respective research with deep investigation under supervisory faculty members, and the internship subjects taught by faculty members in the Cooperative Graduate School System with companies, research institutes, etc. Particularly, Advanced Research help students understand widely the process of identifying problems to solving them ingeniously and gain the skill of conducting a research project and rounding it up into research outcomes. 6. Through special researches in the Doctoral Program, students gain the “global communication” ability, which is the “ability to fulfill one's given role shares, bring out high communication ability and take a leadership position in a research team or research project” . This ability can be more deeply gained through Advanced Group Project Based Learning in Risk and Resilience Engineering, in which students commit themselves to group research activities as an advisor of each group, in “Group Project Based Learning in Risk and Resilience Engineering” , in which students in the Master's Program are divided into groups and assigned to work on a theme. Furthermore, serving as a chairperson in special seminars in the Doctoral Program, the ability to promote communication among students that include oneself while taking a leadership position is cultivated. Those students who pursue to become university faculty members can use these subjects as a PFP (Preparing Future Professionals) program. The “ability to be active in international scenes through their high presentation ability”, which is part of “global communication” , is gained through special seminars in the Doctoral Program, in which students are mandatorily required to make presentations in the foreign language with regard to their research and learning. In addition, this ability can be more deeply gained through special researches in the Doctoral Program, where students carry out their research and present the outcomes at international conferences, etc. under the supervision of supervisory faculty members. The achievement progress of the requirements is periodically checked in accordance with the achievement evaluation scheme described below, and along the degree of achievement, the student receives appropriate advice from the faculty member, who is the achievement evaluation board member responsible for the student.

Admission Policy

Desired Student Profile	We seek candidates who are interested in widely understanding risks and their countermeasures and want to meet the challenge of risk and resilience in elucidating and evaluating problems in reality using their cross-disciplinary ability to have the big picture in mind from an interdisciplinary perspective. We welcome those who possess the basic abilities in the mathematics and information processing skills, which serve as the foundation of engineering, and on the other side, have the desire to improve themselves in the linguistic skill, communications and presentation abilities to be internationally active in the actual world as well as the motivation in passing along their outcomes to the society through industry-academia collaboration, social collaboration, education and research outcomes, etc.
Student Selection Process	To select out enrollments, diverse candidates are sought through the general entrance exam, special entrance exam for adults or other enrollment selection methods. The opportunity of entrance exam is offered multiple times in the same year with the split of the number of persons admitted. For the selection of enrollment, candidates are required to take an oral exam which includes a presentation, and questions and answers. In addition, within the special entrance exam for adults, the Program offers a system of both day and night courses to allow working individuals to take courses at the Tokyo campus while keeping their jobs (day and night courses program for working individuals). – The internal assessment selection selects those who are expected to complete the Master's Program in Risk and Resilience Engineering, who possess especially high fundamental abilities and research abilities. – In the general entrance exam, the potential students to be selected out must possess certain fundamental abilities and research abilities. – The special entrance exam for adults evaluates the achievements and experiences as an adult member of society in addition to fundamental abilities and research abilities.

Learning Support Framework

Academic Support	(1) Advanced Seminar in Risk and Resilience Engineering In these exercises, students meet weekly, with designated students delivering research presentations or literature reviews, followed by Q&A to deepen learning. Discussions proceed from interdisciplinary perspectives that transcend individual specializations, cultivating the broad outlook required in the field of risk and resilience and putting into practice instruction that emphasizes real-world relevance. (2) System for Enrolling in a Broad Range of Common Subjects across the Degree Program Groups The Risk and Resilience Engineering Degree Program has established a system that enables students to systematically take diverse common-subject courses offered across the degree program groups. Specifically, students may choose courses—according to their interests—related to Social Engineering, Service Engineering, Risk and Resilience Engineering, Computer Science and Engineering, Intelligent Systems, Structural and Energy Engineering, and Empowerment Informatics. Through this interdisciplinary curriculum, students build study plans aligned with their interests while cultivating a broad perspective and cross-disciplinary problem-solving skills.
Opportunities for Peer Interaction	(1) Advanced Group Project Based Learning in Risk and Resilience Engineering This doctoral-level course, Advanced Group Project Based Learning in Risk and Resilience Engineering, aims to cultivate supervisory skills by having doctoral students participate as advisors to student groups in the Master's required course, Group Project Based Learning in Risk and Resilience Engineering. By guiding the entire process—from problem formulation and project management to synthesizing outcomes and delivering presentations—students systematically acquire the leadership competences expected of research supervisors. (2) Collaboration among Teaching Assistants within the Degree Program Within the Degree Program, the Teaching Assistants (TAs) who support the cluster of required courses are organized as a unified unit called “GP-TA”, and a collaborative framework that includes faculty has been established. Specifically, regular meetings led by a coordinating faculty member are used to share approaches to course support and operational considerations, and to clarify role allocation and communication channels. GP-TAs also take the lead in sharing operational know-how and providing mutual feedback, and they participate in the planning and operation of the Risk Engineering Research Meetings, thereby contributing to improving the overall quality of educational activities across the program. These activities also serve as a forum for consultation and interaction among TAs and support smooth collaboration in a multinational cohort. As a result, stronger peer effects among students are expected, along with higher motivation to learn, more consistent quality in educational support, and improvements in the quality of each student's research.

Opportunities for Student–Faculty Interaction	(1) Advanced Seminar in Risk and Resilience Engineering In these exercises, students prepare their presentation materials under the supervision of their academic advisor before presenting. Multiple faculty members—not necessarily from the same field—then attend to provide evaluations and advice. This process introduces multifaceted perspectives that are not confined to a single discipline and enables diverse viewpoints to be incorporated into the research, ultimately leading to further refinement of the work. (2) Risk Engineering Research Meetings (RERM) The Degree Program has continuously held the Risk Engineering Research Meetings since 2002, originating in the former Department of Risk Engineering, and as of 2025 has hosted more than 230 sessions. At each meeting, distinguished and up-and-coming researchers and practitioners are invited, providing students with opportunities to encounter the latest research trends and societal issues and to deepen their understanding and discussion of risk assessment in an increasingly complex society. (3) Regular Faculty-Student Liaison Meetings To identify students' questions and requests regarding educational and research facilities, curriculum, assessment, and career development and job search, and to provide a forum for exchanging opinions and information between students and faculty, liaison meetings are held twice a year (spring and fall). These meetings help improve the educational environment and enhance students' motivation to learn. (4) Internship Opportunities through the Resilience Research and Education Promotion Consortium The Degree Program provides internship opportunities at institutions participating in the Consortium, where students gain practical experience under the guidance of researchers and faculty members with specialized knowledge and skills, affiliated with the Cooperative Graduate School system. Through this experience, which bridges theory and practice, students strengthen both their research capabilities and their practical competence.

Approaches to Assuring and Enhancing Educational Quality

(1) Achievment Evaluation System

- The achievement evaluation system is used to assess students' learning outcomes and to verify the validity of the curriculum and the appropriateness of instruction.
- An achievement evaluation board is established to ensure the quality of education and to strengthen the framework for achieving the objectives of the degree program through continuous review and improvement of all educational activities.
- This achievement evaluation system is improved at all times in accordance with the PDCA cycle defined below.

Plan: Plan an achievement evaluation system and draw up implementation details, standards, etc.

Do: Evaluate the achievements of each student individually by multiple faculty members.

Check: Cross-check how the achievement evaluation system is formulated against how it is actually used.

Act: Improve detected problems in the system or usage.

(2) Workshops for Newly Appointed Faculty

The FD (Faculty Development) Committee organizes workshops for new faculty members upon appointment. These workshops include explanations of the educational philosophy by the program leader and introduce unique educational improvement measures (e.g., achievement evaluation) of the Risk and Resilience Engineering Degree Program. Participants also bring their PCs to learn how to use internal university platforms (TIPS, RISS, FAIR, TWINS, etc.) with hands-on access support.

(3) Implementation and Utilization of Course Evaluations

The FD Committee conducts course evaluations using TWINS, aggregates the results, and shares them with all faculty members. This allows faculty to appropriately understand students' opinions regarding course management and to use this feedback for improving their teaching practices.