Master's Program in Risk and Resilience Engineering

Master of 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 Master's Program in Risk and Resilience Engineering seeks to cultivate highly specialized professionals who possess 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 fundamental engineering ability, the foundations and associated information processing techniques for risk and resilience analysis and evaluation, and by adapting them from a wide 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 come up with 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 sufficient communication ability, and if required, taking a leadership position.

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	①If the basic knowledge in the areas of risk and resilience engineering was gained ②If the academic abilities as highly specialized professionals in the areas of risk and resilience engineering were gained
	7. Knowledge of foundations and associated techniques: Knowledge of the foundations for risk and resilience analysis and evaluation, and associated information processing techniques	①If the foundations for analyzing risks potential in complex phenomena and evaluating them from a resilience viewpoint were gained ②If the information processing techniques for analyzing risks potential in complex phenomena and evaluating them from a resilience viewpoint were gained

	Competences	Evaluation perspectives
Knowledge and Skills	8. Knowledge about problems in reality: Knowledge about problems in reality that involve risk and resilience engineering	If the knowledge about the problems in reality, to which risk and resilience engineering is applied, was gained
	9. Ability to have the big picture in mind from a wide perspective: Ability to interpret, from a wide perspective, the issues to which risk and resilience engineering is applied	If a wide perspective for interpreting the issues, to which risk and resilience engineering is applied, was gained
	10. Ability to identify and solve problems: Ability to understand the process from identifying to solving a risk-resilience problem using engineering means and come up with and develop the concrete means to provide a solution	①If problems are led to concrete solutions with the understanding of the application of specialized skill—— Solution process starting from problem identification ②If 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 sufficient communication ability, and if required, take a leadership position in a research team or research project	①If one's given role shares are fulfilled in a research team or research project ②If sufficient communication ability is brought out, and if required, a leadership position is taken in a research team or research project

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 advanced professionals in engineering were gained ②Knowledge of basic theories and related skills: Knowledge of fundamental theories for risk and resilience analysis and assessment, and knowledge of information processing technologies related to risk and resilience analysis and assessment were gained ③Knowledge of issues in the real world: 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 perspective was gained ⑤Abilities of problem setting and solving: Ability to understand the process from setting up problems to solving them by engineering means, and to devise and develop specific solutions for problems related to risk and resilience were gained ⑥Global communication ability: Ability to fulfill assigned roles in a research team or research project, demonstrate adequate communication skills, and take on leadership roles as needed 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. 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 Master's 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. Note that the review of the research outcomes of specific tasks (the “specific task research report”) can take the place of the review of master's thesis. <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 or usefulness. 3. The thesis must be appropriately constructed and the content must be correct. (1) The theme of the thesis must be appropriate. (2) The backgrounds and purposes of research must be clear. (3) The methods of research must accord with the purposes. (4) Results must be correctly drawn. (5) Discussion must be argued based on results. (6) The conclusion must be clear. (7) Citations must be appropriate. <Criteria for specific task research report review> 1. The report 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 or usefulness. 3. The report must be appropriately constructed and the content must be correct. (1) The theme of the report must be appropriate. (2) The backgrounds and purposes of research must be clear. (3) The methods of research must accord with the purposes. (4) Results must be correctly drawn. (5) Discussion must be argued based on results. (6) The conclusion must be clear. (7) 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 master's thesis review board formed by one chief reviewer and two or more sub-reviewers. The chief reviewer and two or more sub-reviewers must be faculty members of Degree Programs in Systems and Information Engineering. Opening a master's thesis review board, the chief reviewer evaluates the thesis in accordance with the criteria for degree thesis review and judges the acceptance of the thesis after having obtained approval of the board. The thesis passes if approved to be on a master's thesis level in all of the above evaluation items 1 to 3 with the final exam included in the judgment.

Curriculum Policy

The curriculum is organized to attain the Diploma Policy requirements listed above and cultivate human resources who possess the specialized knowledge and research ability for risk and resilience engineering (risk and resilience engineering infrastructure, information system security, urban disaster prevention and social resilience, environment and energy systems), a wide range of basic knowledge and ethical view in the areas of engineering, and can be effective immediately for the comprehensive analysis of risks latent in complex social phenomena from a wide perspective that extends over multiple areas in science and technology.

Curriculum Design Framework	In the Master's Program, Degree Programs' Common Courses are organized with Major Subjects and Foundation Subjects for Major, and Program subjects, with Major Subjects and Foundation Subjects for Major. With Program subjects, students learn with lectures and seminars to cultivate presentation and communication abilities and a wide perspective and also take the project subjects, which help students understand the process from identifying to solving problems using engineering means and develop means to provide a solution. Degree Programs' Common Courses, students learn the foundations and information processing techniques of each of the areas and take the subjects for deepening the knowledge of actual problems involving risk studies. The Program subjects help students deepen the understanding of other areas than that of his or her own area of expertise. Students attain the requirements enumerated in Diploma Policy by incorporating the learning in these subjects and the research of each student's area of expertise into a degree thesis or specific task research report.
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. “Foundations and associated techniques”, which is covered in almost all of the subjects, is gained though the subjects provided in the Degree Program. Particularly through Special Master's Research Work, students can learn more deeply the 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 specialized subjects. 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, students can learn more deeply through the internship subjects taught by those faculty members. 5. The abilities to “identify and solve problems” are gained through Special Master's Research Work, in which each student carries out their respective research under supervisory faculty members, and the internship subjects taught by faculty members in the Cooperative Graduate School System with companies, research institutes, etc.

Teaching and Learning Methods	6. The abilities for “communication” are gained through Special Master's Seminar, Special Master's Research Work and Project Research. In addition, students can learn more deeply through risk and resilience engineering group PBL seminars, etc., in which they are divided into groups and assigned to work on a theme. 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 understanding a wide range of 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. While the knowledge in a specific area is not necessarily required to learn in the Master's Program in Risk and Resilience Engineering, we welcome those who have interests in the mathematics and information processing skills, which serve as the foundation, and on the other side, have the desire to improve themselves in the communication and presentation abilities to be 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 recommendation entrance exam, 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 and submit the official transcript meeting the application eligibility in correspondence with the characteristics of the area. To prove foreign language proficiency, candidates are required to submit the score sheet of English language test (e.g. TOEIC, TOEFL). – In the recommendation entrance exam, the candidates must remarkably excel academically and possess the sufficient knowledge and research abilities in the areas of risk and resilience engineering. – 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) Seminar in Risk and Resilience Engineering I and II 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	Group Project Based Learning in Risk and Resilience Engineering In the required first-year course of the Master's Program, “Group Project Based Learning in Risk and Resilience Engineering”, groups of three to four students from different fields are formed to pursue project-based learning (PBL) on problems they define themselves. Through meetings and discussions, students engage with peers from diverse backgrounds, share specialized knowledge and perspectives, and generate new ideas and solutions. Interim, final, and poster sessions also involve other groups and upper-year students, enabling wide-ranging exchanges of views through Q&A. Through these activities, students are expected to strengthen their collaborative skills in small interdisciplinary research teams as well as their interdisciplinary thinking.

Opportunities for Student–Faculty Interaction	(1) Seminar in Risk and Resilience Engineering I and II 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) Group Project Based Learning in Risk and Resilience Engineering In this course, each group is assigned a faculty advisor—distinct from the students' academic supervisor—who provides guidance and advice on topic selection and research methods. During presentation sessions, evaluations and comments are also offered by faculty members other than the group advisor, thereby promoting cross-disciplinary learning and network building. (4) 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. (5) 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.