

## Doctoral Program in Chemistry

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### ■ Doctor of Philosophy in Science

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#### Program Educational Objectives

The Doctoral Program in Chemistry cultivates highly versatile researchers who propose leading-edge research themes in the areas of chemistry, appropriately formulate research plans, smoothly driving such research forward, and can practice all of these independently with ingenuity from a global view whether in academia or industry.

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<b>Graduate Profile</b>	He or she should have the clear intention and sincere attitude to contribute to the world through chemistry, and the ability to plan and drive forward research independently with the understanding of social needs, communication ability and linguistic skill capable of negotiating in the international society, as well as the ability to provide or pass along such research findings to the society through their academic papers, etc. and also should couple all of these abilities with a high ethical view in their research activities.
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### Diploma Policy

The degree of Doctor of Philosophy in Science 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
<b>Knowledge and Skills</b>	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. Specialized chemical knowledge: Theoretical and practical knowledge about physical chemistry, organic chemistry and inorganic/analytical chemistry, and the ability to put it into use in actual research scenes	If theoretical and practical knowledge about physical chemistry, organic chemistry and inorganic/analytical chemistry, and the ability to put it into use in actual research scenes were gained

	Competences	Evaluation perspectives
<b>Knowledge and Skills</b>	7. Logical thinking and problem-solving ability: Ability to analyze and solve problems by logical thinking	If the ability to analyze and solve problems by logical thinking was gained
	8. English proficiency specialized in chemistry: Ability to use English in carrying out a presentation and question-and-answer session and writing a paper as to chemical research	If the ability to use English in carrying out a presentation and question-and-answer session and writing a paper as to chemical research was gained
	9. Ability to drive research forward: Ability to set up research tasks and draw up long-term and short-term research plan	If the ability to set up research tasks and draw up long-term and short-term research plan was gained
	10. Research ethical view of good quality: Ability to appropriately handle and store research data and to appropriately cite other researchers' findings	If research data are appropriately handled and stored and if other researchers' findings are appropriately cited
<b>Guidelines for Assessing Learning Outcomes</b>	<p>For the oral presentation at the mid-term review (held from the autumn semester of the second year through the spring semester of the third year) all academic supervisors evaluate the student's acquisition of competences specified in the diploma policy, based on a rubric.</p> <p>At the time of doctoral thesis submission, all academic supervisors verify and evaluate the student's attainment of competences stipulated in the diploma policy, based on the "Achievement Evaluation Sheet".</p> <p>For the oral presentation in the doctoral thesis defence in the final year, one chief examiner and at least two sub-examiners evaluate the student's acquisition of competences specified in the diploma policy, based on a rubric.</p> <p>One and a half years after admission, an achievement evaluation is conducted. Following confirmation and guidance from individual supervisors, all research supervisors verify and evaluate the results.</p>	

<p><b>Evaluation Criteria for Degree Theses/ Dissertations</b></p>	<p><b>【Review board members】</b>  A thesis review board, which is set up with a chief reviewer (supervisory faculty member) and three sub-reviewers, is launched.  The chief and sub-reviewers must be doctor's degree holders. In addition, the chief reviewer must belong to Tsukuba (including the Cooperative Graduate School System), and the sub-reviewers, to Tsukuba (including the Cooperative Graduate School System) or a research institution approved by the professor meeting in the chemical field.</p> <p><b>【Review method】</b>  The chief and sub-reviewers review the submitted doctoral dissertation.  A doctoral dissertation review board opens and arranges the oral presentation and oral exam of the doctoral degree candidate to evaluate the comprehension of research content and the achievement of the research. After the board finishes evaluation, the dissertation reviewers have an evaluation meeting and decides on the final acceptance.</p> <p><b>【Review items】</b></p> <ol style="list-style-type: none"> <li>1. The submitted doctoral dissertation must have a high level of completeness including the description, logical development and graphics.</li> <li>2. The doctoral dissertation content must be on the world's high level standards as research in the areas of chemistry.</li> <li>3. The doctoral dissertation must have references cited appropriately.</li> <li>4. The doctoral dissertation must show the sufficient contribution of the doctoral degree applicant.</li> <li>5. Preceding researches must be deeply understood and the disciplinary position of the research theme must be clear.</li> <li>6. The doctoral dissertation content must be deeply understood and the question-and-answer session in the presentation must be carried out appropriately.</li> </ol> <p><b>【Level standards required for the degree thesis】</b>  The dissertation passes if approved to be on a doctoral dissertation level in all criteria 1 to 5 and if approved to have an appropriate level of doctoral degree diploma with criterion 6 met in the presentation and oral exam in the doctoral dissertation review board.</p>
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## Curriculum Policy

The curriculum places four large frameworks which include the boundary areas with life sciences and engineering, etc. in addition to inorganic/analytical chemistry, physical chemistry and organic chemistry, which form the foundation of chemistry. This system allows a research theme to involve a wide range of chemical areas. Through this specialized research, students conduct leading-edge research to experimentally and theoretically elucidate the structures and properties of various chemical substances as well as chemical reaction mechanisms, etc. at the molecular level. With this, students learn the chemical concepts covering from the foundation to application of chemical substances and also the advanced and very specialized techniques of experiment and research.

<p><b>Curriculum Design Framework</b></p>	<ul style="list-style-type: none"> <li>- The curriculum is finely organized to let Major Subjects include exercises and seminars, which are offered with evaluation that is very carefully arranged in several steps so that students can gain the specialized contents of chemistry and also the abilities appropriate to a doctoral degree in science.</li> <li>- In exercises and seminars, students are always required to raise problems and propose solutions as to their own research and experiment as well as their dissertations with leading-edge research. In this way, students are thoroughly supervised to possess the logic to be able to analyze data precisely and objectively and also the ability to formulate their own research plans.</li> <li>- Above all, Research Proposal, which is a required subject, helps students develop the ability to independently unearth problems and plan a research.</li> <li>- In addition, some exercises and Graduate General Education Courses serve to train students to gain communication ability and linguistic skill.</li> <li>- As for the research area of each student, students learn advanced contents under the personal attention of supervisory faculty members in charge.</li> </ul>
<p><b>Teaching and Learning Methods</b></p>	<ul style="list-style-type: none"> <li>- The curriculum places four large frameworks which include the boundary areas with life sciences and engineering, etc. in addition to inorganic/analytical chemistry, physical chemistry and organic chemistry, which form the foundation of chemistry.</li> <li>- The curriculum is finely organized to let Major Subjects include exercises and seminars, which are offered with evaluation that is very carefully arranged in several steps.</li> <li>- Above all, Research Proposal, which is a required subject, helps students develop the ability to independently unearth problems and plan a research.</li> </ul>

### Admission Policy

<b>Desired Student Profile</b>	The Program seeks those who possess the sufficient scientific skills, logical and rational thinking abilities and linguistic skill cultivated in a master's program and can challenge problems persistently toward solutions. The Program, which seeks to cultivate researchers and highly specialized professionals possessing the advanced specialized knowledge and abilities to contribute to the society by playing a role in chemistry's progression in actual cutting-edge research scenes, welcomes those who can be actively committed to learning and research with a strong desire to learn to attain what the Program aims.
<b>Student Selection Process</b>	In light of Desired Students, diverse candidates who possess the qualities and abilities appropriate as potential researchers or highly specialized professionals are selected. Candidates are evaluated from multifunctional and comprehensive points of view with consideration for fairness and diversity.

### Learning Support Framework

<b>Academic Support</b>	Through a support system consisting of co-supervisor and specialised fields (inorganic/analytical chemistry, physical chemistry, and organic chemistry), objectivity in research guidance and responsiveness to a variety of consultations are ensured. By providing opportunities to participate in lectures and seminars outside of the student's own specialised research field, as well as research presentation meetings and study groups, support is given for deepening research, along with guidance in presentation skills and writing support.
<b>Opportunities for Peer Interaction</b>	By providing opportunities to participate in events such as research presentation meetings and career path lectures, where students from different academic years gather, a system is established to promote interaction among students across years and groups through QandA sessions and open discussions. Through the Semikai (a degree-program-wide seminar), opportunities are provided for interaction among students across research fields and academic years.
<b>Opportunities for Student-Faculty Interaction</b>	Faculty members of the degree program participate in the "Research Proposal", providing opportunities for interaction with faculty outside the student's own specialty through exchanges of opinions and discussions. Through the Semikai (a degree-program-wide seminar), opportunities are provided for interaction with faculty members other than the supervisor and co-supervisors. Meetings between graduate students and the faculty council are held to provide opportunities for interaction with faculty members other than the supervisor and co-supervisors.

### Approaches to Assuring and Enhancing Educational Quality

Through ongoing reviews and improvements of overall educational activities—conducted in settings such as meetings between graduate students and faculty—we will ensure the quality of education and strengthen the framework for achieving the goals of the degree program