

## Doctoral Program in Chemistry

Name of the degree to be conferred	Doctor of Philosophy in Science
Educational purpose	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.
Vision of human resources development	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.

### 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 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. 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

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

#### Dissertation evaluation criteria

##### 【Review board members】

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.

##### 【Review method】

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.

##### 【Review items】

1. The submitted doctoral dissertation must have a high level of completeness including the description, logical development and graphics.
2. The doctoral dissertation content must be on the world's high level standards as research in the areas of chemistry.
3. The doctoral dissertation must have references cited appropriately.
4. The doctoral dissertation must show the sufficient contribution of the doctoral degree applicant.
5. Preceding researches must be deeply understood and the disciplinary position of the research theme must be clear.
6. The doctoral dissertation content must be deeply understood and the question-and-answer session in the presentation must be carried out appropriately.

##### 【Level standards required for the degree thesis】

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.

#### 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.

Curriculum organization policy	<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>
Learning methods • Processes	<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>
Evaluation of learning outcomes	<ul style="list-style-type: none"> <li>• Foundation Subjects for Major: If the fundamental abilities appropriate to a doctoral degree in science were gained for the research area</li> <li>• Foundations in associated areas: If the fundamental abilities appropriate to a doctoral degree in science were gained for the areas associated with the research</li> <li>• Knowledge about problems in reality: If insight appropriate to a doctoral degree in science was gained as to problems in reality</li> <li>• Wide perspective: If a wide perspective appropriate to a doctoral degree in science was gained</li> <li>• Problem identification to solution: If the ability to identify problems in an area of specialty and lead them to concrete solutions was gained.</li> <li>• Presentation and communication abilities: If the logical presentation and communication abilities appropriate to a doctoral degree in science were gained</li> <li>• Academic outcomes: If research outcomes appropriate to a doctoral degree in science were accomplished. The achievements in these evaluation items are checked with careful supervision and evaluation repeated at each of the preparatory stages, including the Research Proposal review, interim report review, preliminary dissertation review, dissertation review, and final exam.</li> <li>• To grant a degree, all of the examinations need to be passed. As for academic outcomes, the publication of dissertation in a peer-reviewed international academic journal is required as a diploma requirement to confirm that the content works on an international level. The important guidelines to be applied for the evaluation of achievements are as follows: If the ability to propose a leading-edge research theme based on his/her own idea was gained; if he or she drew up an appropriate research plan in the research that he or she conducted, and based on this plan, the research was driven forward; and if research findings were organized as an academically highly significant dissertation.</li> </ul>

## Admission Policy

**Desired students**                      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.

**Selection policy**                      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.