

Curriculum Map: Graduate School of Environmental Engineering
Graduate Programs in Environmental Systems (Doctoral Program) (Core Subjects are own-graduate programs subjects only)

Course: Resources and Chemical Systems

⊙: Closely related ○: Related △: Somewhat related

| Subject Category | Class Subject | Diploma Policy | | | Diploma Policy | | |
|---|---|--------------------------------------|---|--|---|---|---|
| | | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation |
| Core Subjects | Advanced Energy Chemistry | ⊙ | ○ | | This class aims at acquiring knowledge about energy chemistry. | You can understand energy chemistry, search for solutions, and express your opinion logically from a professional perspective. | |
| | Advanced Kinetics and Reaction Engineering | ⊙ | ○ | | Thorough study on the theory of chemical reaction kinetics and reaction mechanism for the students to apply it to their own research work. | Presentation by every student about his/her own research from the view point of reaction kinetics and mechanism and discussion with other students. | |
| | Advanced Inorganic Materials Engineering | ⊙ | ○ | | To acquire physicochemical properties, synthesis methods, characterization methods, and application areas of various inorganic crystalline compounds. | To digest some academic research papers on inorganic compounds written in English and to evaluate the value of the papers from his/her point of view. | |
| | Advanced Catalytic Reaction Chemistry | ⊙ | ○ | | To acquire advanced knowledge about catalysis based on physicochemical properties of catalysts, and to understand essence of catalyst design. | To acquire logical thinking for accurately solving problems after understanding essence of problems in catalyst design. | |
| | Spectroscopic Analysis | ⊙ | ○ | | Based on crystallographic knowledge, acquire knowledge about structural analysis methods mainly using X-ray diffraction. | Acquire the ability to judge crystal structures from information such as the symmetry of substances and the ability to identify and express structural differences using crystal structure drawing software. | |
| | Advanced Separation and Purification Engineering | ⊙ | ○ | | Obtaining professional and systematic knowledge for separation and purification technologies and processes of materials. | Obtaining abilities to think comprehensively and to offer solution theoretically from professional point of view for the separation and purification methods of materials. | |
| | Advanced Solid State Materials Chemistry | ⊙ | ○ | | Students will acquire knowledge of the relationship between the structure and bonding of solids, and the interaction between crystals and electronic structures that affect physical properties. | Through experiments such as X-ray diffraction, microscopy, and thermal analysis, students will acquire the skills to analyze the structure and properties of solids. | |
| | Advanced Process Design | ⊙ | ○ | | Acquisition of the chemical processes and separation processes. | Acquisition of logical thinking ability to grasp individual problems of reaction processes and separation processes. | |
| | Applied Materials Systems | ⊙ | ○ | | A systematic and comprehensive understanding of advanced material systems. | Being able to think scientifically about the need for advanced materials, seek solutions, and clearly express one's thoughts and judgments. | |
| | Advanced Polymer Chemistry | ⊙ | ○ | | To acquire knowledge in detail on the physics and chemistry of polymer substances and understand their essence. | To understand the essence of complex materials and to acquire the skill of logical thinking to formulate the optimum solution. | |
| | Advanced Environmental Chemistry | ⊙ | ○ | | To understand professional information about principles, function, characteristic and quality control of analytical methods and equipment for trace chemical analysis in environments. | To achieve the skill to consider the best method to analyze target materials and to explain the reason. | |
| | Advanced Air Pollution and Its Controlling Engineering | ⊙ | ○ | | To be able to systematically and comprehensively understand the atmosphere, atmospheric science and atmosphere chemistry and to be able to apply them. | To be able to logically and scientifically discuss/consider the air pollution, the atmospheric sciences and their experiments and results and to be able to appropriately publish the outcomes/results. | |
| | Advanced Recycling Engineering | ⊙ | ○ | | Relevant technical skills and knowledges for analysis of biochemical reactions and material transfer phenomena on biological wastewater treatments. | Skills to calculate/optimize biological/physical/chemical reactions using the process simulator. | |
| | Advanced Aquatic Environment Engineering | ⊙ | ○ | | Comprehensive and systematic understanding about conservation of aquatic environment. | Considering the solution for the problem of aquatic environment and expressing the own idea. | |
| | Advanced Geosphere Environment Treatment | ⊙ | ○ | | Acquire specialized knowledge of remediation technologies for contaminated soil. | To be able to comprehensively consider soil contamination, seek solutions, and express one's ideas appropriately. | |
| | Advanced Recycling-System Engineering | ⊙ | ○ | | Acquire very high level of knowledge in the recycling field. | Acquire advanced problem-solving skills based on knowledge in the recycling field. | |
| | Advanced Sustainable Sanitation Engineering | ⊙ | ○ | ○ | Relevant sense to adopt the technologies on solid waste treatments to reduce organic pollutions. | Sense to fix the environmental challenges based on the background and the relating technologies. | Sense to elaborate strategies to reduce the environmental pollutions/problems, by identifying trade-off relationships which might present during the solution. |
| | Advanced Research Methods of Environmental Issues in Asia | ○ | ○ | ⊙ | Have broad and systematic knowledge of environmental issues in Asia | Provide professional views to find solutions to environmental issues in Asia | Continue to have professional intentions to solve environmental issues in Asia |
| | Special Lectures on Resources Chemical Systems | ⊙ | ○ | ○ | A systematic and comprehensive understanding of the resource chemistry system. | Be able to think comprehensively and logically about chemistry and environmental science, seek solutions, and clearly express one's thoughts and opinions from a professional standpoint. | Continue to have an interest in resource chemistry and a career consciousness and acquire an attitude that can contribute to future industries. |
| | Advanced Ecological and Environmental Physiology | ⊙ | ○ | ○ | Knowledge on the chemical and physical interactions between living organisms (especially plants and micro-organisms) and the surrounding environments through specific case studies and mathematical basis reported to date must be obtained. | Empirical and theoretical approaches towards solving the environmental and biological problems must be understood. | Ethics behind the biological and environmental sciences and technologies must be learned. |
| | Advanced Functional Microbiology | ⊙ | ○ | ○ | The ability to develop advanced knowledge systematically and comprehensively about microbial culture design, industrial use, and ecology by understanding the diversity of microorganisms. | The ability to comprehensively understand about the deep connection with industrial use by acquiring specialized knowledge on the physiological functions of microorganisms. And the ability to propose solutions and send out ideas. | The ability to have the high level of interests and career awareness in the field of microorganisms and to have future prospects for the microbial industry. |
| | Advanced Biophysics | ⊙ | ○ | ○ | Understand biophysics and acquire specialized knowledges. | To acquire the fundamentals of biophysics and its professional application skills. | To develop an interest and motivation for research and development in biophysics. |
| | Advanced Computational Chemistry | ⊙ | ○ | ○ | Acquiring the specialized knowledge of computational chemistry. Acquiring the skills to use typical computational chemistry software depending on the task. | Capable of thinking computationally and chemically about chemical events, seeking the solutions, and expressing own thoughts logically from a professional standpoint. | Acquiring an interest continuously in fields such as environment, life, and medical care, a career consciousness, and an attitude of proactive action. |
| | Advanced Biomaterials | ⊙ | ○ | ○ | You can acquire specialized knowledge and skills related to biomaterials. | You can acquire the ability to discover problems in the development of biomaterials and logically derive solutions to them. | You can understand the current state of biomaterial development and can contribute to its development. |
| | Advanced Biosensor Engineering | ⊙ | ○ | ○ | Students are required to acquire specialized and general knowledge necessary to understand the biological sensor engineering. | Students are required to think logically about the principles of biological sensors and issues in the development. Further, they are required to express them clearly in presentations. | The ability to have the high level of interests and career consciousness in the field of biology and chemistry. |
| | Advanced Ecosystem Science | ⊙ | ○ | ○ | Attendees should master theoretical analysis of ecological phenomena and develop the theory for applying to their specific research subject. | Attendees are requested to give lecture on the individual ecological phenomena relating to their specific research topics including their own research achievement. | Attendees are requested to understand the bioethics properly based on the ecological theory and to actively develop them in their research career. |
| | Advanced Environmental Biology | ⊙ | ○ | ○ | Students are required to acquire specialized and practical knowledge necessary to understand the relationship between life and the environment. | Students are required to analyze factors that contribute to various environmental issues and make science-based decisions. | Students are required to propose solutions to various global issues with consideration for the co-evolution of life and the Earth. |
| | Advanced Molecular and Cellular Biosciences | ⊙ | ○ | ○ | To acquire professional, original, and practical knowledge in the molecular and cellular biology fields, and to acquire the skills to solve the issues flexibly and independently as a scientist. | To have the abilities to original thinking and decisions about issues in the molecular and cellular biology fields and to present useful knowledge and information in papers or at conferences. | To have the abilities to find essential issues in the molecular and cellular biology fields, to take action to solve the issues autonomously, and to collaborate with domestic and international researchers. |
| | Advanced Urban Environmental Management | ⊙ | ○ | ○ | Acquire specialized, creative, and practical knowledge about the mechanism of urban environmental problems and their management methods. | In order to deal with actual urban environmental problems, acquire the thinking ability and judgment ability to deal with the problems from a broad perspective not only in Japan but also in developing countries. | Be interested in the development and environmental issues behind urban environmental issues at domestic and abroad, and acquire the motivation to practice advanced study. |
| | Advanced Energy and Environmental Engineering | ⊙ | ○ | ○ | Acquire a wide range of knowledge about energy and the environment in a systematic and comprehensive manner. | To be able to think about energy and environmental issues from an interdisciplinary and multifaceted perspective, to seek solutions, and to express one's thoughts and judgments appropriately. | Develop an interest in and career awareness of energy and environmental issues, and an attitude of working to solve problems. |
| Advanced Sustainable Management | ⊙ | ○ | ○ | To get the professional, creative and practical knowledge on environmental management and business. | To be able to make enforcement, judgment and representation from the standpoint of environmental management and business. | To have the interest and motivation in conduction of specialized research on environmental management and business. | |
| Advanced Environmental Information Technology and Computer Simulation | ⊙ | ○ | | To acquire comprehensive practical knowledge of environmental information and assessment techniques. | To be able to think comprehensively from the standpoint of advanced academic research and seek solutions to environmental impact assessment, and be able to express their ideas and judgments logically. | | |
| Advanced Studies in Environmental Pollution and Health Risks | ⊙ | ○ | ○ | Understand concepts of risk assessment and risk governance. | Logically compare solutions and select appropriate ones to deal with risks. | Continuously apply a rational approach for dealing with risks. | |
| Advanced Environmental Principles | ⊙ | ○ | | Ability to reconstruct the conceptual framework for examining environmental issues. | | | |
| Thesis Research | Thesis Research | ○ | ⊙ | ○ | Acquire a wide range of knowledge about a given research subject systematically and comprehensively. | Acquire the ability to formulate own research plans and evaluate their effects based on logical analysis from the viewpoint of chemistry. | Acquire an attitude of acting independently to contribute to the future society by having a continuous interest in own research themes. |

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Course: Biosystems

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| Thesis Research | Thesis Research | ○ | ⊙ | ○ | Students will acquire knowledge and technology to be able to perform a plan, action, evaluation, improvement to achieve research target. | Students can suggest problems and solution in research and development and will acquire an ability to be able to accomplish effectively by collaborating with others. | Students have a strong interest for research target and will acquire the posture capable of acting independently to achieve the purpose. |

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Graduate Programs in Environmental Systems (Doctoral Program) (Core Subjects are own-graduate programs subjects only)

Course: Environmental and Ecological Systems

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| | Advanced Energy and Environmental Engineering | ⊙ | ○ | ○ | Acquire a wide range of knowledge about energy and the environment in a systematic and comprehensive manner. | To be able to think about energy and environmental issues from an interdisciplinary and multifaceted perspective, to seek solutions, and to express one's thoughts and judgments appropriately. | Develop an interest in and career awareness of energy and environmental issues, and an attitude of working to solve problems. |
| Advanced Sustainable Management | ⊙ | ○ | ○ | To get the professional, creative and practical knowledge on environmental management and business. | To be able to make enforcement, judgment and representation from the standpoint of environmental management and business. | To have the interest and motivation in conduction of specialized research on environmental management and business. | |
| Advanced Environmental Information Technology and Computer Simulation | ⊙ | ○ | ○ | To acquire comprehensive practical knowledge of environmental information and assessment techniques. | To be able to think comprehensively from the standpoint of advanced academic research and seek solutions to environmental impact assessment, and be able to express their ideas and judgments logically. | | |
| Advanced Studies in Environmental Pollution and Health Risks | ⊙ | ○ | ○ | Understand concepts of risk assessment and risk governance. | Logically compare solutions and select appropriate ones to deal with risks. | Continuously apply a rational approach for dealing with risks. | |
| Advanced Environmental Principles | ⊙ | ○ | ○ | Ability to reconstruct the conceptual framework for examining environmental issues. | | | |
| Thesis Research | Thesis Research | ○ | ⊙ | ○ | Acquire a wide range of academic knowledge about your field of expertise and learn how to draw conclusions from an academic perspective. | Understand research issues from multiple perspectives and be able to present necessary solutions with academic evidence. | Clearly recognize their role as professionals working on environmental issues and act proactively as a leader. |

* Refer to applicable curriculum maps for subjects of other graduate programs.

Curriculum Map: Graduate School of Environmental Engineering
Graduate Programs in Environmental Engineering (Doctoral Program) (Core Subjects are own-graduate programs subjects only)

Course: Mechanical Systems Engineering

⊕: Closely related ○: Related △: Somewhat related

| Subject Category | Class Subject | Diploma Policy | | | Diploma Policy | | |
|---|--|--------------------------------------|---|--|--|---|---|
| | | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation |
| Core Subjects | Special Lectures on Heat Power Systems | ⊕ | ○ | ○ | High technical knowledge related to thermal engineering in the energy system field is acquired. | Students put on the high thinking power and judgement in the harmony with the environment in development and design of energy equipment. | Students have a strong interest and motivation for technological development of energy equipment, and are willing to clarify the essence of the problem. |
| | Special Lectures on Flow Control Systems | ⊕ | | △ | Professional academic skills in mechanical engineering with creative and practical knowledge of pipe flow in the field of compressible fluid mechanics. | | A strong interest and motivation in technological development in mechanical engineering, and a willingness and attitude to clarify the problems in the field of compressible fluid dynamics from the standpoint of a researcher and educator, who are willing to seek out appropriate ways to deal with these problems. |
| | Special Lectures on Design Systems | ⊕ | △ | △ | To acquire professional knowledge about design, processing, materials, measurement of a machine structure, and to acquire creative and practical technology development ability. | To acquire logical thinking ability, and to acquire accurate expression ability of research results. | To have the strong interest in the technology development, and to contribute to society as a researcher. |
| | Special Lectures on System Control Engineering | ⊕ | △ | △ | To acquire specialized knowledge about the system control engineering systematically and comprehensively. | To consider comprehensively and search a solution, and able to send own thought and judgment logically, about system control engineering. | To have an interest in and a career consciousness of a design and manufacturing system continually, and acquire the posture to contribute to society as a researcher or an engineer. |
| | Special Lectures on Measuring Systems | ⊕ | | △ | Acquire specialized knowledge of measurement systems. | | To be motivated to work on engineering applications of measurement systems. |
| | Supervised Research on the Urban Environment and Ecological Design | ○ | ⊕ | ○ | At the end of the course, participants are expected to (1) Acquire more practical and advanced expertise in urban development that considers resource saving, energy saving, and coexistence with nature. | (2) Acquire presentation skills to send out original solutions to the international problems of the urban environment. | (3) Acquire independence to search for solutions of international urban environment issues in the field of advanced academic research. |
| | Supervised Research on the Environmental Design of Living Spaces | ⊕ | △ | ○ | At the end of the course, participants are expected to (1) Acquire advanced expertise to understand literature and materials related to living environment design. | (2) Be able to propose plans that solve problems of living environment design. | (3) Acquire attitude to work on problem solving with an ethical sense as a global-environment-conscious engineer. |
| | Supervised Research on Environmentally Conscious Materials Engineering | ⊕ | ○ | ○ | At the end of the course, participants are expected to (1) Obtain advanced practical knowledge about environment-conscious materials and advanced skills to analyze survey results and data. | (2) Discovery international problems of environment-conscious materials, and apply problem-solving ability learned in the course to the problems. | (3) Obtain ability and willingness to solve the problems based on the Research Tradition. |
| | Supervised Research on Trans-Generational Architectural Design | ⊕ | △ | ○ | Acquire advanced expertise in building and building a sustainable society from the past to the future. | Acquire the expressive power to analyze survey materials and data at a high level and disseminate them to society in an appropriate manner. | Acquire a high sense of ethics and an attitude of cooperating with others in organizations and society to solve problems in order to build a sustainable social system. |
| | Supervised Research on Urban Environmental Engineering | ⊕ | ○ | ○ | Acquire advanced specialized knowledge to understand literature and materials related to urban environmental engineering. Acquire advanced design planning technology related to urban environmental engineering. | Acquire thinking process and problem extraction ability through overseas literature and materials related to urban environmental engineering. | Acquire the attitude of having problem-solving ability through the promotion of projects related to urban environmental engineering. |
| | Supervised Research on Environmental Engineering in Architecture | ○ | ⊕ | △ | Acquire advanced specialized knowledge and practical research / analysis / evaluation skills regarding architectural environmental control systems. | Acquire practical problem-solving and expressive abilities at a high academic research level regarding the rational formation and maintenance mechanism of the building environment. | Acquire the interest in various problems related to the building environment and willingness to work on problem solving from the standpoint of advanced academic research. |
| | Supervised Research on Structural Analysis | ⊕ | | | Students acquire understanding of specialized knowledge on structural analysis. | | |
| | Supervised Research on Building Systems and Construction Methods | ⊕ | | | Graduate students should acquire the theoretical and practical knowledge of "the building systems and construction methods" required for building design and construction, as well as various abilities as a building engineer necessary to create a comfortable space using that knowledge. | | |
| | Supervised Research on Building Facilities Systems | | ⊕ | | | Acquire the ability to think, judge, and express for problem extraction and solution at the advanced academic research level while considering the environment, energy, and economic efficiency of the environmental equipment system. | |
| | Supervised Research on Building Materials | ⊕ | ○ | ○ | Students should have more practical and advanced expertise in building materials, and have the skills to highly summarize and analyze survey materials and numerical data related to building materials. | By making full use of the advanced specialized skills gained in class, students should be able to extract international issues related to building materials and should acquire the expressive power to disseminate their solutions to society. | Students should have the motivation and attitude to solve problems while systematically promoting projects in cooperation with others in the region or organization for international issues of building materials from the standpoint of advanced academic research. |
| Supervised Research on Low Carbon Architecture and Urban Design | ○ | ⊕ | ○ | Acquire more practical and advanced expertise in low-carbon architecture and cities, and use that knowledge to acquire skills in research, analysis, and evaluation of various case studies. | Through case studies and presentations on low-carbon architecture and cities, acquire the expressive skills to identify issues and provide society with creative solutions based on the ingenuity at the academic research level. | Understand the significance and importance of contributing to the global environment, have an interest in environmental issues at the architectural and urban levels, and have the motivation to explore the essence of the issues and work to solve them from the standpoint of academic research. | |
| Thesis Research | Thesis Research | ○ | ⊕ | ○ | To acquire specialized knowledge in the field of own research subject and a wide range of knowledge about mechanical systems, systematically and comprehensively. | To think comprehensively about own research subject, search for solutions, and logically express the knowledge gained. | To continue to be interested in research topics and have an attitude of being able to act independently as a mechanical system engineer or researcher. |

* Refer to applicable curriculum maps for subjects of other graduate programs.

Curriculum Map: Graduate School of Environmental Engineering
Graduate Programs in Environmental Engineering (Doctoral Program) (Core Subjects are own-graduate programs subjects only)

Course: Architecture

⊕: Closely related ○: Related △: Somewhat related

| Subject Category | Class Subject | Diploma Policy | | | Diploma Policy | | |
|---|--|--------------------------------------|---|--|--|---|---|
| | | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation |
| Core Subjects | Special Lectures on Heat Power Systems | ⊕ | | | High technical knowledge related to thermal engineering in the energy system field is acquired. | | |
| | Special Lectures on Flow Control Systems | ⊕ | | | Professional academic skills in mechanical engineering with creative and practical knowledge of pipe flow in the field of compressible fluid mechanics. | | |
| | Special Lectures on Design Systems | ⊕ | | | To acquire professional knowledge about design, processing, materials, measurement of a machine structure, and to acquire creative and practical technology development ability. | | |
| | Special Lectures on System Control Engineering | ⊕ | | | To acquire specialized knowledge about the system control engineering systematically and comprehensively. | | |
| | Special Lectures on Measuring Systems | ⊕ | | △ | Acquire specialized knowledge of measurement systems. | | To be motivated to work on engineering applications of measurement systems. |
| | Supervised Research on the Urban Environment and Ecological Design | ○ | ⊕ | ○ | At the end of the course, participants are expected to (1) Acquire more practical and advanced expertise in urban development that considers resource saving, energy saving, and coexistence with nature. | (2) Acquire presentation skills to send out original solutions to the international problems of the urban environment. | (3) Acquire independence to search for solutions of international urban environment issues in the field of advanced academic research. |
| | Supervised Research on the Environmental Design of Living Spaces | ⊕ | △ | ○ | At the end of the course, participants are expected to (1) Acquire advanced expertise to understand literature and materials related to living environment design. | (2) Be able to propose plans that solve problems of living environment design. | (3) Acquire attitude to work on problem solving with an ethical sense as a global-environment-conscious engineer. |
| | Supervised Research on Environmentally Conscious Materials Engineering | ⊕ | ○ | ○ | At the end of the course, participants are expected to (1) Obtain advanced practical knowledge about environment-conscious materials and advanced skills to analyze survey results and data. | (2) Discovery international problems of environment-conscious materials, and apply problem-solving ability learned in the course to the problems. | (3) Obtain ability and willingness to solve the problems based on the Research Tradition. |
| | Supervised Research on Trans-Generational Architectural Design | ⊕ | △ | ○ | Acquire advanced expertise in building and building a sustainable society from the past to the future. | Acquire the expressive power to analyze survey materials and data at a high level and disseminate them to society in an appropriate manner. | Acquire a high sense of ethics and an attitude of cooperating with others in organizations and society to solve problems in order to build a sustainable social system. |
| | Supervised Research on Urban Environmental Engineering | ⊕ | ○ | ○ | Acquire advanced specialized knowledge to understand literature and materials related to urban environmental engineering. Acquire advanced design planning technology related to urban environmental engineering. | Acquire thinking process and problem extraction ability through overseas literature and materials related to urban environmental engineering. | Acquire the attitude of having problem-solving ability through the promotion of projects related to urban environmental engineering. |
| | Supervised Research on Environmental Engineering in Architecture | ○ | ⊕ | △ | Acquire advanced specialized knowledge and practical research / analysis / evaluation skills regarding architectural environmental control systems. | Acquire practical problem-solving and expressive abilities at a high academic research level regarding the rational formation and maintenance mechanism of the building environment. | Acquire the interest in various problems related to the building environment and willingness to work on problem solving from the standpoint of advanced academic research. |
| | Supervised Research on Structural Analysis | ⊕ | | | Students acquire understanding of specialized knowledge on structural analysis. | | |
| | Supervised Research on Building Systems and Construction Methods | ⊕ | | | Graduate students should acquire the theoretical and practical knowledge of "the building systems and construction methods" required for building design and construction, as well as various abilities as a building engineer necessary to create a comfortable space using that knowledge. | | |
| | Supervised Research on Building Facilities Systems | | ⊕ | | | Acquire the ability to think, judge, and express for problem extraction and solution at the advanced academic research level while considering the environment, energy, and economic efficiency of the environmental equipment system. | |
| | Supervised Research on Building Materials | ⊕ | ○ | ○ | Students should have more practical and advanced expertise in building materials, and have the skills to highly summarize and analyze survey materials and numerical data related to building materials. | By making full use of the advanced specialized skills gained in class, students should be able to extract international issues related to building materials and should acquire the expressive power to disseminate their solutions to society. | Students should have the motivation and attitude to solve problems while systematically promoting projects in cooperation with others in the region or organization for international issues of building materials from the standpoint of advanced academic research. |
| Supervised Research on Low Carbon Architecture and Urban Design | ○ | ⊕ | ○ | Acquire more practical and advanced expertise in low-carbon architecture and cities, and use that knowledge to acquire skills in research, analysis, and evaluation of various case studies. | Through case studies and presentations on low-carbon architecture and cities, acquire the expressive skills to identify issues and provide society with creative solutions based on the ingenuity at the academic research level. | Understand the significance and importance of contributing to the global environment, have an interest in environmental issues at the architectural and urban levels, and have the motivation to explore the essence of the issues and work to solve them from the standpoint of academic research. | |
| Thesis Research | Thesis Research | ○ | ⊕ | ○ | At the end of the course, participants are expected to (1) Obtain more advanced specialized knowledge through research in specialized field. | (2) Obtain practical thinking, discernment, and expressiveness through advanced research. | (3) Recognize importance of problem-solving with ethics through advanced research, and apply in the real world problems as a researcher or an engineer. |

* Refer to applicable curriculum maps for subjects of other graduate programs.

**Curriculum Map: Graduate School of Environmental Engineering
Graduate Programs in Information Engineering (Doctoral Program) (Core Subjects are own-graduate programs subjects only)**

Course: Computer Science

⊕: Closely related ○: Related △: Somewhat related

| Subject Category | Class Subject | Diploma Policy | | | Diploma Policy | | |
|----------------------------|---|--------------------------------------|---|---|---|--|--|
| | | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation |
| Core Subjects | Advanced Adaptive Signal Processing | ⊕ | ○ | ○ | Students have acquired general specialized knowledge in the field of information technology, and the highly specialized knowledge on adaptive signal processing and artificial intelligence. They also have acquired skills in designing and implementing signal processing in instrumentation and communication systems. | Students will be able to develop effective adaptive processing algorithms for adaptive system design, analyze theoretically and evaluate their performance in practical applications. Moreover, students can present the academic results in international publications. | As researchers in the field of computer science, students can communicate effectively with others in the community and organization and act autonomously to deal with the practical signal processing problems based on a sense of social responsibility and ethics. |
| | Advanced Visual Information Processing | ○ | ○ | ○ | Extensive and systematic knowledge about visual information processing of human and machinery | Ability to express one's own opinion logically about the issues concerning visual information processing | Ability to gather recent information about issues concerning visual information processing based on one's own interest |
| | Advanced Applied Pattern Recognition | ⊕ | ○ | ○ | Acquisition of advanced knowledge in pattern recognition | Enabling to inquire into advanced issues regarding pattern recognition and suggest new solution | Continuing to have an interest in pattern recognition and a motivation for suggesting future prospects in the field |
| | Advanced Information Security | ⊕ | ○ | ○ | Acquire advanced knowledge on information security. | Consider logically, explore solutions, and express their opinions from a professional perspective in an appropriate manner. | Have interest in information security and career consciousness, and acquire an attitude to act independently as a researcher. |
| | Advanced Image Processing | ⊕ | ○ | ○ | Acquire advanced specialized knowledge on image processing. | Find advanced issues related to image processing and show its novel solutions. | Present a future vision of image processing technology that contributes to the development of an advanced information society. |
| | Advanced Mobile Communication Systems | ○ | ○ | ○ | Gain a wide range of expertise in mobile communication systems and design. | Define advanced mobile communication systems and find its solution. | Ability to design advanced mobile communication systems, explore solutions, and express their opinions logically from a professional perspective. |
| | Advanced Information and Communication Theory | ⊕ | ○ | ○ | Acquire advanced knowledge on understanding information and coding theory. | Explore solutions and clearly express their opinions on issues related to advanced information and communication theory. | Have interest in advanced information and communication technology and a career consciousness of it, and acquire an attitude to contribute. |
| | Advanced Combinatorial Optimization | ○ | ○ | ○ | To obtain the special expertise of combinatorial optimization. | To obtain that the high-level problem of the combinatorial optimization is inquired and its solution is shown. | To obtain that the highly deep knowledge of combinatorial optimization is obtained and the development of its novel optimization is motivated. |
| | Advanced VLSI Physical Design | ○ | ○ | ○ | Systematically and comprehensively understand the advanced knowledge of physical design in the VLSI design process. | Acquire the skills to design the layout and verify the performance of VLSI by using a dedicated system for VLSI design based on their advanced expertise. | Act with an awareness of the technologies necessary for the development of the semiconductor industry to learn and acquire new technologies. |
| | Advanced System Control Theory | ⊕ | ○ | ○ | To systematically and comprehensively understand the robust control theory of linear systems based on the state-space representation and the transfer function. | To find solutions to the problems of the robust control system design by applying the robust control theory and present the solutions from a professional point of view clearly. | To keep having an interest and career awareness in the robust control system design, and be willing to design new robust control systems applying the robust control theory. |
| | Advanced Network Architecture | ⊕ | ○ | ○ | Systematically and Comprehensively recognize specialized knowledge about network architecture. | Comprehensively explore solutions, and logically describe your opinions and judgments from a professional viewpoint of network architecture. | Strongly concern network architecture and career consciousness, and desire to develop new technologies toward a highly sophisticated information society. |
| | Advanced Medical Engineering | ○ | ○ | ○ | It is necessary to have a wide range of advanced expertise and skills related to both biological and engineering technologies. | It is possible to set advanced issues related to biomedical engineering and have problem-solving ability and expressiveness for them. | Have high ethical standards and autonomous abilities related to biomedical engineering, and acquire the ability to carry them out. |
| | Advanced Embedded Hardware Systems | ○ | ○ | ○ | Students systematically and comprehensively acquire basic and specialized knowledge of embedded hardware. | Students are able to think comprehensively and logically about embedded hardware to explore solutions and to express their ideas from a professional perspective in a logical and appropriate manner. | Students maintain an interest in embedded hardware and career awareness and develop the attitude to act independently as a specialist in information technology. |
| | Advanced Machine Learning | ⊕ | ○ | ○ | You will have a high level of expertise in machine learning. | You can explore issues related to machine learning with logical thinking, and appropriately express your opinions as a specialist of machine learning. | You will be continuously interested in machine learning and be motivated to start your career as a research scientist. |
| Advanced Behavior Analysis | ○ | ○ | ○ | Understand the various perspectives on data in behavior science. | Skilled to plan experiments for behavior science to obtain specific knowledge. | Discerning about behavioral data considering social effects. | |
| Thesis Research | Thesis Research | ○ | ⊕ | ○ | Acquisition of basic academic skills and specialized knowledge in computer science as well as the ability to design and implement information systems as a doctor's degree in the research field. | Develop a creative solution for issues in the field of computer science, and derive a conclusion by evaluating the performance of the practical results, and write an academic paper by summarised these processes, and present it internationally. | As a researcher in the field of computer science, communicate effectively with others in community and organizations, and work autonomously to solve problems based on a sense of social responsibility and ethics. |

* Refer to applicable curriculum maps for subjects of other graduate programs.

**Curriculum Map: Graduate School of Environmental Engineering
Graduate Programs in Information Engineering (Doctoral Program) (Core Subjects are own-graduate programs subjects only)**

Course: Applied Information Systems

Ⓢ: Closely related ○: Related △: Somewhat related

| Subject Category | Class Subject | Diploma Policy | | | Diploma Policy | | |
|----------------------------|---|--------------------------------------|---|---|---|--|--|
| | | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation | DP I Specialist knowledge and skills | DP II Advanced problem-solving and expressive abilities | DP III Ability to function autonomously with a solid ethical foundation |
| Core Subjects | Advanced Adaptive Signal Processing | ○ | ○ | ○ | Students have acquired general specialized knowledge in the field of information technology, and the highly specialized knowledge on adaptive signal processing and artificial intelligence. They also have acquired skills in designing and implementing signal processing in instrumentation and communication systems. | Students will be able to develop effective adaptive processing algorithms for adaptive system design, analyze theoretically and evaluate their performance in practical applications. Moreover, students can present the academic results in international publications. | As researchers in the field of computer science, students can communicate effectively with others in the community and organization and act autonomously to deal with the practical signal processing problems based on a sense of social responsibility and ethics. |
| | Advanced Visual Information Processing | Ⓢ | ○ | ○ | Extensive and systematic knowledge about visual information processing of human and machinery | Ability to express one's own opinion logically about the issues concerning visual information processing | Ability to gather recent information about issues concerning visual information processing based on one's own interest |
| | Advanced Applied Pattern Recognition | ○ | ○ | ○ | Acquisition of advanced knowledge in pattern recognition | Enabling to inquire into advanced issues regarding pattern recognition and suggest new solution | Continuing to have an interest in pattern recognition and a motivation for suggesting future prospects in the field |
| | Advanced Information Security | ○ | ○ | ○ | Acquire advanced knowledge on information security. | Consider logically, explore solutions, and express their opinions from a professional perspective in an appropriate manner. | Have interest in information security and career consciousness, and acquire an attitude to act independently as a researcher. |
| | Advanced Image Processing | ○ | ○ | ○ | Acquire advanced specialized knowledge on image processing. | Find advanced issues related to image processing and show its novel solutions. | Present a future vision of image processing technology that contributes to the development of an advanced information society. |
| | Advanced Mobile Communication Systems | Ⓢ | ○ | ○ | Gain a wide range of expertise in mobile communication systems and design. | Define advanced mobile communication systems and find its solution. | Ability to design advanced mobile communication systems, explore solutions, and express their opinions logically from a professional perspective. |
| | Advanced Information and Communication Theory | ○ | ○ | ○ | Acquire advanced knowledge on understanding information and coding theory. | Explore solutions and clearly express their opinions on issues related to advanced information and communication theory. | Have interest in advanced information and communication technology and a career consciousness of it, and acquire an attitude to contribute. |
| | Advanced Combinatorial Optimization | Ⓢ | ○ | ○ | To obtain the special expertise of combinatorial optimization. | To obtain that the high-level problem of the combinatorial optimization is inquired and its solution is shown. | To obtain that the highly deep knowledge of combinatorial optimization is obtained and the development of its novel optimization is motivated. |
| | Advanced VLSI Physical Design | Ⓢ | ○ | ○ | Systematically and comprehensively understand the advanced knowledge of physical design in the VLSI design process. | Acquire the skills to design the layout and verify the performance of VLSI by using a dedicated system for VLSI design based on their advanced expertise. | Act with an awareness of the technologies necessary for the development of the semiconductor industry to learn and acquire new technologies. |
| | Advanced System Control Theory | ○ | ○ | ○ | To systematically and comprehensively understand the robust control theory of linear systems based on the state-space representation and the transfer function. | To find solutions to the problems of the robust control system design by applying the robust control theory and present the solutions from a professional point of view clearly. | To keep having an interest and career awareness in the robust control system design, and be willing to design new robust control systems applying the robust control theory. |
| | Advanced Network Architecture | ○ | ○ | ○ | Systematically and Comprehensively recognize specialized knowledge about network architecture. | Comprehensively explore solutions, and logically describe your opinions and judgments from a professional viewpoint of network architecture. | Strongly concern network architecture and career consciousness, and desire to develop new technologies toward a highly sophisticated information society. |
| | Advanced Medical Engineering | Ⓢ | ○ | ○ | It is necessary to have a wide range of advanced expertise and skills related to both biological and engineering technologies. | It is possible to set advanced issues related to biomedical engineering and have problem-solving ability and expressiveness for them. | Have high ethical standards and autonomous abilities related to biomedical engineering, and acquire the ability to carry them out. |
| | Advanced Embedded Hardware Systems | Ⓢ | ○ | ○ | Students systematically and comprehensively acquire basic and specialized knowledge of embedded hardware. | Students are able to think comprehensively and logically about embedded hardware to explore solutions and to express their ideas from a professional perspective in a logical and appropriate manner. | Students maintain an interest in embedded hardware and career awareness and develop the attitude to act independently as a specialist in information technology. |
| | Advanced Machine Learning | ○ | ○ | ○ | You will have a high level of expertise in machine learning. | You can explore issues related to machine learning with logical thinking, and appropriately express your opinions as a specialist of machine learning. | You will be continuously interested in machine learning and be motivated to start your career as a research scientist. |
| Advanced Behavior Analysis | Ⓢ | ○ | ○ | Understand the various perspectives on data in behavior science. | Skilled to plan experiments for behavior science to obtain specific knowledge. | Discerning about behavioral data considering social effects. | |
| Thesis Research | Thesis Research | ○ | Ⓢ | ○ | Acquire special knowledge of information systems systematically. | For the issues of the information systems, explore their solutions from the professional perspective and express their own opinions and conclusions logically. | Take their own volition to conduct their research activity independently and contribute to society. |

* Refer to applicable curriculum maps for subjects of other graduate programs.