Dept. of Climate Technology Convergence

Climate change is a global main issue, and there is no doubt that the risks will pose a great threat to the survival of all living things including mankind on the earth. Therefore, humankind should make efforts to be carbon neutral to reduce and adapt to the risks of climate change. Our graduate degree program aims to develops carbon sinks and renewable carbon free energies and related policies, particularly with bioresources-based carbon upcycling technologies, which are a key field in the transition to a carbon-neutral society to solve the globally recognized seriousness of climate change. Our program was created to educate the theoretical and practical ability to design alternatives that can be used in the actual policy stage. The program will provide convergence education between related fields such as forest resources and carbon sink management, climate technology design and policy, bioenvironmental material technology, and energy fusion technology under the theme of bioenergy technology, which is one of the solutions for responding to and reducing climate change impacts. Our department aims to nurture high-level researchers who will lead the carbon-neutral era.

☐ Courses

❑ Climate Technology Convergence Major Courses

· Topics in Forest Biomass Management (3)

This course discusses factors and processes affecting the composition, growth and development of forest biomass, and issues related to the management and renewal of biomass resources are discussed. In addition, the possibility of forest biomass in response to climate change will be discussed through field trips to case sites for establishing and utilizing forest biomass and with small joint projects.

· Topics in Global Carbon Sink Management (3)

This course focuses on learning the methodology for establishing and managing overseas carbon sink. Additionally, it aims to understand the mechanism of REDD+, which is highlighted as an important solution for climate change adaptation. The course also involves grasping the mechanisms of REDD+ and analyzing practical cases of REDD+ implementation.

· Carbon Dynamics Modeling (3)

Complex interactions between climate change and ecosystems occur depending on the properties and current status of the major carbon pools in the ecosystem, and the movement between carbon pools, causing various natural and human changes. Therefore, in order to properly understand and cope with the causes, mitigation, and adaptation of climate change, a systematic understanding of carbon dynamics is required, and various modeling methodologies and theoretical backgrounds used as

tools for this are studied and practiced in this course.

· **Topics in Environmental GIS (3)**

Students will learn advanced GIS analysis techniques and their applications to decision-making for sustainable forest management.

· **Topics in Carbon Inventory (3)**

The function of the forest environment as a carbon sink is very important. It needs to maximize these functions through various forestry and environmental management, and accurate carbon inventory evaluation is required to effectively implement, evaluate and manage them. In this course, we will learn and discuss carbon inventory theories and techniques used in the human social environment as well as the forest environment and ecosystem.

· **Biomass Resource Assessment & Management (3)**

This course will reviews theories and case studies related to biomass resource survey, evaluation, and management systems, and the direction of development is discussed. In addition, students will learn various GIS analysis functions, techniques, and procedures used in the spatial decision support process for calculating and managing biomass resources.

· **Topics in Carbon Sink Management (3)**

This course is aimed to understand technologies and policies related to carbon sink management, and to cultivate the ability to continuously develop technologies and methodologies for maintaining, increasing, and restoring carbon sinks. In addition, we discuss carbon emission reduction-related projects and case studies in the international community, such as desertification prevention and REDD+.

· **Microbiome (3)**

Microorganisms that are closely related to our lives affect us as a group of diverse species rather than a single species. In this course, the microbiome's impact on our environment and health, microbiome analysis methods, and microbiome improvement methods are studied with a focus on advanced molecular biology methods. Based on these things, the students will learn through discussion so that new technologies or improvement methods related to microbiome can be suggested.

· **Seminar in Microorganism Utilization (3)**

This course discusses various types of microorganisms and their functions that can be utilized in environmental materials related to climate change and carbon neutrality, such as forest carbon sink restoration. Additionally, it explores challenges in the utilization of microorganisms and engages in discussions on approaches to address these challenges.

· **Advanced Bio- and Nanocomposites (3)**

Students will learn the latest research trends and case studies for the application of bioplastics, biocomposites based on woody and non-woody cellulose, and nanocomposites that are fused with various functional nanomaterials. In addition, the applied new technology and manufacturing method are discussed, and the applicability of forest biomass resources is examined through analysis of various properties and characteristics using the latest equipment.

· **Current Topics in Wood-based Environment & Materials (3)**

You can learn the technologies applied in the wood-based residential environment and various eco-friendly building materials fields, and the latest processing. The students acquire practical skills to respond to climate change and pioneer the future.

· **Topics in Cellulosic Thin Layer Materials (3)**

This course studies the raw material characteristics and manufacturing process of nanocellulose, and discuss the theoretical principles and application technologies of thin film materials using nanoization and solution technology, which are recently applied as new materials.

· **Current Topics in Paper-based New Material Application (3)**

Paper is being used as a natural new material for various special purposes. This course will deal with and the raw materials, processes, and latest application cases.

· **Pretreatment Techniques for Biomass (3)**

This course studies the concept of a fermentable sugar production platform, which is the basis for producing biofuels or biopolymers using biomass as a raw material, and learn to use it in the pretreatment process of lignocellulose, which is the most important process in the conversion process to fermentable sugar. In addition, the students will discuss various pre-treatment technologies and application cases for various raw materials.

· **Current Topics in Biomaterials Application (3)**

This course is aimed to understand the chemical structure, properties, and characteristics of raw materials of biomaterials produced by the biomass conversion process, and also to understand the fields of application of biomaterials by finding and discussing the latest projects for the development and application of these biomaterials.

· **Seminar in Climate Disaster Monitoring (3)**

This course explores methodologies for monitoring and analyzing climate-related disasters such as wildfires, landslides, and pest outbreaks using advanced ICT technologies. Discussions will take place through seminars with external experts.

· **Bio Sensor Technology (3)**

Measurement of physical and chemical signals is the basis of all control. Among these sensor technologies, in the case of a sensor targeting a living organism, various materials and measurement technologies must be used effectively. In this course this class, students will study the types and operating principles of biosensors.

· **Energy Plant Engineering (3)**

Students will acquire in-depth knowledge necessary to plan and design an energy power plant, and to procure and complete the necessary raw materials. In particular, this course will improve understanding of plant process design technology, safety reliability technology, and core equipment technology related to bioenergy production, conversion and use in response to climate change.

· **Biomass Thermochemical Engineering (3)**

This course will improve the understanding and ability to utilize a representative thermochemical conversion method of an energy production system using biomass as a renewable and carbon-neutral resource. In particular, an in-depth discussion will be held on biochar generation and the process of producing value-added materials and synthetic gas using gasification technology.

· **Plant Computational Modeling (3)**

In this course, the students model the plant to be used in the heat conversion process of bio-resources through mathematical modeling and computational simulation, and discuss practical application possibilities and problems of the modeled plant.

· **Advanced Analytical Chemistry (3)**

In this course, the theory of various analysis methods (structural analysis, surface analysis, electrochemical analysis, spectroscopic analysis, etc.) required for R&D in the energy/environment field is understood in depth, and the case studies for application are reviewed and discussed in detail.

· **Electrochemistry (3)**

Students will understand the basic theory of electrochemistry, which is a core study in the future energy/environmental industry, including solar cells, secondary cells, and water electrolysis devices. In addition, thermodynamic and kinetic aspects of electrochemistry are covered along with various electrochemical analysis methods.

· **Nano Technology for Energy and Device System (3)**

Students will learn theories and cases studies related to new materials for nano-energy systems such as synthesis, processing, and carbon materials of nanomaterials. Through the study of the following nanotechnology, the

understanding and application of future energy related to climate change will be improved based on the discussion on the application of nanotechnology.

· **Advanced Materials for Energy Storage (3)**

Based on the theory of electrochemical/mass transfer phenomenon, which is the core of next-generation energy storage technology, this course will study the understanding, limitations, and application cases of lithium secondary batteries and secondary battery materials using them. Based on this, various pre-treatment technologies and latest cases through recycling of biomass/waste resources/energy storage materials will be discussed.

· **Climate Change Adaptation Technology (3)**

The students comprehensively understand policies for global climate change adaptation and the technologies, and develop the ability to present technologies and policy alternatives in terms of climate change adaptation. In particular, it covers adaptation technologies by fields such as forestry, ecosystem, agriculture, hydrology, health, and the ocean, and learns and discusses the latest cases and technologies handled by the international community and major research institutes.

· **Climate Technology Cooperation and Policy (3)**

This course studies the latest technologies, policies, and international issues related to climate technology, and devlop expertise in climate technology cooperation systems such as cooperation between countries, public-private cooperation, and industry-academia-research cooperation. In addition, the students understand and discuss cases of technology cooperation and projects applied to developing countries such as CTCN using the technology mechanism of the United Nations Framework Convention on Climate Change.

· **Advanced 4th Industry Technology in Paper Industry (3)**

The students understand the technology convergence characteristics of the 4th industrial revolution and deal with application to the paper industry in this course.

· **Biomass Energy Policy (3)**

The students discuss ways to present policy alternatives by analyzing the current status of domestic and foreign biomass energy policies and the strengths and weaknesses of biomass. In addition, the students develop ability to collect and synthesize various opinions of stakeholders related to biomass production, distribution, processing and consumption to propose rational policy alternatives.

· **Seminar in Carbon Sink Policy (3)**

This course aims to enhance understanding of domestic and international policies for the maintenance and enhancement of carbon sink. It focuses on cultivating the ability to develop and implement policies for carbon sink. Additionally, the course involves researching actual cases where carbon sink policies have been implemented,

comparing the strengths and weaknesses of each case, and exploring sustainable ways to enhance carbon sink through policy simulation analysis.

· **Urban Planning for Carbon Neutral Cities (3)**

The direction of carbon-neutral urban planning is discussed through carbon-neutral city-related theories, application cases, and policy analysis. In addition, students learn applied techniques for realizing a carbon-neutral city, and reinforce urban planning capabilities to respond to climate crisis through project implementation.

· **Climate Policy Leaders Academy (3)**

Through topical discussions with the highest authorities in climate change policy, the students will understand the future direction of global climate change policies and develop practical skills to lead climate change policies. In addition, the students will understand future plans and responses to climate change policies of domestic and overseas national institutions, and discuss ways to improve Korea's leading role and status about climate change in the international community.

· **Forest Carbon and Biodiversity (3)**

The course examines forest management techniques that sustain and enhance carbon sinks through biodiversity. It also teaches research methodologies to identify the interconnections between biodiversity and the carbon storage functions of forests.

· **Seminar in Forest Carbon Monitoring (3)**

This course analyzes and discusses methodologies for scientifically monitoring forest carbon. It also explores the strengths and weaknesses of these methodologies, aiming to discuss future approaches for more accurate and precise forest carbon monitoring.

· **Forest Carbon Sink and Pests (3)**

This course discusses the mechanisms of pest outbreaks that affect the health and sustainability of forests, which are critical carbon sinks. It also explores management strategies for pests, as well as methodologies and policies to control pest outbreaks intensified by climate change.

· **Current Topics in Bioconversion Process (3)**

This course discusses the key technologies for establishing a platform production system through an eco-friendly biomass-based biotransformation process. Specifically, it covers core technologies such as biomass pretreatment, biocatalyst development, conversion process technology, fermentation processes, separation and purification technologies, and application development technologies.

· **Climate Change and Ecosystem Multifunctionality (3)**

The course focuses on methodologies for monitoring changes in ecosystem functions resulting from climate change. It also defines the concept of

multifunctionality, which integrates ecosystem functions and services into a single metric, and explores its practical applications.

- **Carbon Sink and Soil Ecosystem Assessment (3)**

  This course examines the carbon cycling loop between trees and soil in forests, which absorb increasing amounts of carbon dioxide due to climate change. It also teaches methodologies for functionally evaluating the ecosystems of aboveground trees and belowground soil.

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