Dept. of Climate Technology Convergence

Climate change is a critical global issue, and its risks pose a significant threat to the survival of all living beings on Earth. Achieving carbon neutrality is therefore essential to mitigate and adapt to the impacts of climate change. This graduate degree program focuses on the development of carbon sinks, renewable and carbon-free energy sources, and related policies, with particular emphasis on bioresource-based carbon upcycling technologies that are central to the transition toward a carbon-neutral society. The program is designed to cultivate both theoretical knowledge and practical expertise for developing solutions applicable to real-world policy-making. Through a convergence-based curriculum integrating forest resources and carbon sink management, climate technology design and policy, bioenvironmental material technology, and energy fusion technology, the program centers on bioenergy technology as a key approach to climate change mitigation. The department aims to nurture high-level researchers who will lead the carbon-neutral era.

❑ Major in Climate and Environmental Sciences

This major focuses on interdisciplinary research and education addressing climate change mitigation and adaptation through advanced climate and environmental technologies. The program emphasizes the application of remote sensing, geographic information systems (GIS), and artificial intelligence (AI) to identify, develop, and manage carbon sinks and bioresources, as well as ecosystem management technologies designed to optimize bioresource productivity and ecological stability. In addition, the major explores theoretical frameworks and applied technologies for long-term carbon storage based on bio-environmental materials and their industrial applications.

❑ Major in Climate Policy

This major focuses on understanding the evolution of climate change–related policies and global cooperation frameworks at both national and international levels. The program examines interdisciplinary policy theories and implementation strategies and cultivates comprehensive research competencies for designing and implementing key climate policies, including the United Nations Framework Convention on Climate Change (UNFCCC), carbon markets, greenhouse gas inventories, and environmental, social, and governance (ESG) management.

☐ **Courses**

❑ **Core Courses**

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

This course explores global climate change adaptation policies and technologies, focusing on developing the capacity to propose practical policy and technological alternatives. It covers sector-specific adaptation strategies—including forestry, ecosystems, agriculture, hydrology, public health, and oceans—while analyzing the latest case studies and technologies from international organizations and leading research institutes.

· **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. This course is an integrated undergraduate–graduate course.

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

This course explores advanced technologies in wood-based residential environments and eco-friendly building materials. Students will analyze the latest processing techniques and acquire practical skills to enhance carbon storage in the built environment, preparing them to lead sustainable innovations in response to climate change.

· **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. This course is an integrated undergraduate–graduate course.

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

This course examines the characteristics and manufacturing of nanocellulose, focusing on the theoretical principles of thin-film materials. Students explore nanoscale processing and solution-based technologies to develop advanced applications for these emerging materials in the bio-based industry.

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

This course covers essential technologies for establishing platform production systems based on eco-friendly biomass bioconversion. Students will explore key processes, including biomass pretreatment, biocatalyst development, conversion and fermentation processes, and separation/purification technologies, alongside the

development of diverse industrial applications.

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

Paper is increasingly used as a sustainable, nature-based material for specialized applications. This course explores paper-based raw materials, manufacturing processes, and recent technological developments, with a focus on innovative applications and environmental performance.

· **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. This course is an integrated undergraduate–graduate course.

· **Topics in LULUCF Technical Review (3)**

This course examines the technical review (TER) process and criteria for the LULUCF inventory, a core component of the BTR report. By strengthening students' ability to interpret IPCC methodology and compare reporting approaches, the course builds advanced competencies required to serve as international technical review experts.

❑ **Climate and Environmental Sciences Major Courses**

· **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. This course is an integrated undergraduate–graduate course.

· **Climate Adaptive Biology (3)**

This course examines the physiological, genetic, and ecological mechanisms by which organisms adapt to climate change. Students analyze the effects of key climatic factors—such as temperature, moisture, and atmospheric composition—on biological processes and adaptive responses. The course also introduces experimental and molecular approaches and reviews recent research in climate adaptation.

· **Microbiome (3)**

This course explores the microbiome as a complex community of diverse species and its impacts on human health and the environment. Using advanced molecular biology techniques, students study microbiome analysis and enhancement methods. Through discussions, the course develops the capacity to propose innovative technologies and strategies for microbiome improvement.

· **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.

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

This course examines the latest research trends in bioplastics, cellulose-based biocomposites, and functional nanocomposites. Students will explore innovative manufacturing processes and the integration of nanomaterials with forest biomass. Through the analysis of physical and chemical properties using state-of-the-art instrumentation, the course evaluates the industrial applicability and sustainability of advanced bio-based materials.

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

This course analyzes scientific methodologies for monitoring forest carbon stocks. By evaluating the strengths and limitations of current approaches, students will explore advanced strategies to enhance the accuracy and precision of future forest carbon monitoring systems. This course is an integrated undergraduate–graduate course.

· **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. This course is an integrated undergraduate–graduate course.

· **Carbon Dynamics Modeling (3)**

This course explores the complex interactions between climate change and ecosystems by analyzing carbon pools and their fluxes. To effectively address climate mitigation and adaptation, students will develop a systematic understanding of carbon dynamics. The course combines theoretical foundations with practical training in diverse modeling methodologies, providing the tools necessary to predict and manage ecosystem responses to environmental change.

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

This course examines the carbon cycling mechanisms between trees and forest soils as vital carbon sinks in response to climate change. Students will learn scientific methodologies to evaluate the functional roles of both aboveground (biomass) and belowground (soil) ecosystems, focusing on their capacity for carbon sequestration and ecosystem stability. This course is an integrated undergraduate–graduate course.

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

This course focuses on the technologies and policies essential for carbon sink management. Students develop expertise in enhancing and restoring carbon sequestration capacities. In addition, the course examines international initiatives and case studies, including desertification prevention and REDD+, to analyze global strategies for carbon emission reduction.

❑ **Climate Policy Major Courses**

· **Global Climate Leadership (3)**

This course examines the roles and competencies of global leadership required in the era of climate change. Students will gain an understanding of the scientific basis of climate change and global governance frameworks such as the UNFCCC and the Paris Agreement. The course also addresses key global agendas—including the Sustainable Development Goals (SDGs), carbon neutrality, and climate justice—and develops students' strategic thinking and collaborative leadership skills through case studies and international cooperation examples. This course is an integrated undergraduate–graduate course.

· **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.

· **Climate Risk Management (3)**

This course addresses the physical climate change risks faced by nations and businesses, as well as the risks associated with transitioning to a low-carbon society. It also explores ways to mitigate climate risk and leverage it strategically. It discusses responses to climate initiatives like the TCFD and risk management strategies through carbon markets.

· **Climate Change and Sustainable Society (3)**

This course provides an integrated understanding of the scientific basis of climate change and its social, economic, and ecological impacts. Students will explore mitigation and adaptation strategies for building a sustainable society, including topics such as carbon neutrality, energy transition, ecological restoration, green technologies, and social resilience. Through interdisciplinary discussions, the course emphasizes sustainable development pathways in the era of climate crisis.

· **Advanced Climate Policy (3)**

This course provides a comprehensive understanding of climate change policies at the global, national, and regional levels, and comprehensively addresses greenhouse gas reduction, carbon neutrality, and climate change adaptation. Furthermore, it designs climate change response policies, explores new solutions, and discusses feasible policy development strategies at the national and institutional levels. This course is an integrated undergraduate–graduate course.

· **Topics in Greenhouse Gas Inventory (3)**

Under the Enhanced Transparency Framework (ETF) of the Paris Agreement on climate change, the course develops students' capacity to prepare national greenhouse gas inventories and BTR reports for the forestry and land-use (LULUCF/AFOLU) sector. The course also fosters the competencies required of international-level Technical Expert Reviewers (TERs), enabling rigorous technical analysis and assessment of such reports.

· **Topics in Carbon Inventory (3)**

This course highlights the role of forest environments as carbon sinks and the importance of accurate carbon inventory assessment for environmental management. Students examine carbon inventory theories and methodologies across forest ecosystems as well as human and social systems. Through this integrated approach, the course develops practical competencies for implementing and managing global carbon reduction strategies.

· **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.

· **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. This course is an integrated undergraduate–graduate course.

· **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. This course is an integrated undergraduate–graduate course.

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