Dept. of Sustainable Design & Material Innovation

As the industrial systems we have been relying upon are showing their limits, designers must adopt new methodologies to build a more sustainable world. The great changes in the industrial structure and the era of the fourth industrial revolution are an opportunity to change our perspective and develop products and processes with a positive environmental, social, and economic impact.

The Department of Innovative Materials and Renewable Design will create a system that promotes sustainable development by teaching students the technical knowledge necessary to establish closed material loop, improve the production of goods, and pursue energy efficiency.

The course aims to cultivate competent engineers and designers who will play an important role in building a sustainable society by developing innovative materials, products, and services.
The multidisciplinary curriculum combines students and educators with industrial design, new material engineering, and construction system engineering to offer a global perspective on the challenges we face and solutions that can be implemented.

☐ **Major**

The course is focused on developing the professional knowledge of future designers and engineers and develop a deep understanding of the issues we face on a global scale while securing an in-depth knowledge of innovative renewable material and sustainable design strategies.

The theoretical lectures and studio courses will aim at combining the talents and different perspectives of industrial design, advanced material engineering,

and civil and environmental engineering. The goal is to create rich and productive research collaborations and develop new materials and products through the balance of academic theory and practical skills.

❑ **Innovation Product Design Major**

Development of innovative goods and services based on a deep technical and practical understanding

☐ **Courses**

❑ **Innovation Product Design Major**

· **Thesis Research 1, 2 (3)**

With the help of educators, students will be introduced to various research methods and subsequently conduct independent research and study. The course will develop students' knowledge as researchers and acquire academic knowledge and experience to publish an original thesis at the end of the study cycle.

· **Sustainable Design 1, 2 (3)**

The class focuses on recognizing the importance of material research in building sustainable environments and exploring new design possibilities through research on the application of innovative composite materials.

· **Renewable Innovative Product Design Research 1, 2 (3)**

This class will give students an in-depth view of innovative concepts, extend the scope of thinking for renewable product innovation, and allow them to explore new sustainable design directions.

· **Design Start-up Planning (3)**

In this class, pupils will study how to use renewable design technology can be bought to market. They will explore how start-up businesses develop, from the original idea and planning phase to the design of innovative products, introduction to the market, and retail.

· **Renewable Design Research (3)**

The class will help students identify room for the intervention of renewable design technology In the process of experiencing a series of processes from product planning to commercialization, and through this, we seek to reconstruct and rationalize the process.

· **3D printing Project (3)**

Additive manufacturing will play an important role in the development of sustainable societies. This class will be oriented towards material research in 3D printing technology and explore new design possibilities through application research of innovative composite materials.

· **Structural Design and Aesthetic Design (3)**

As safety is primordial, once the mechanics have been identified students will be thought how to improve the structural performances of objects used in real life.

· **Advanced Structural Mechanics and Aesthetic Design (3)**

This class will focus on the indication of the dynamic loads that can be applied to an artifact over its entire usage lifecycle. Students will be trained to verify the behavior of the artifact and learn how to calculate forces and displacements.

· **Advanced Recycling Engineering (3)**

This course provides knowledge on the types of wastes and principles of recycling technologies suitable for valuable materials from wastes, thereby addressing the problems of wastes generated in various industries in terms of resource conservation and environmental conservation. In particular, from the viewpoint of materials science and engineering, this lecture provides economic ways to recycle high-value materials from inorganic industrial wastes.

· **Advanced Eco Materials (3)**

This course includes the science and practical application of the functional organic and inorganic materials that can be applied to green energy and to eco-materials, which can help the physiological environment. Students

participate in the research and development of eco-friendly materials and related technologies based on the convergence of energy & environmental science and material engineering technology and pursue education and research on future-oriented converged technology in which BT, NT, and ET are combined.

· **Renewable Plastic (3)**

This course will consider the manufacturing processes for the production of plastics and composites parts. The emphasis will be on their recycling production, how to categorize the renewable plastics, related issues in our society. Students develop theoretical knowledge and problem-solving skills through intensive coursework and research activities and acquire broad field knowledge and a global sensibility on renewable plastics.

· **Renewable Metals (3)**

This lecture provides basic knowledge on the correlation between structures, processes, and properties of metals, and technologies for recycling metals using physical and chemical methods.

· **Advanced Materials Properties (3)**

This lecture provides basic theories to learn about the effects of structures and processes on mechanical, electrical, thermal, chemical, and magnetic properties of advanced materials.

· **Renewable Business (3)**

This lecture provides basic theories required to start a start-up company, and studies case studies for business based on renewable materials.

· **Seminar in Convergence Engineering (3)**

This lecture provides invited lectures and seminars, focusing on topics related to renewable materials.

· **Convergence Studio (3)**

This is a multi-disciplinary convergence project-based class in which professors with expertise in different fields such as engineering, design, and technology

education students of various majors, to derive creative ideas or products on renewable materials.]

· **Sustainable Design Innovation (3)**

Sustainable Design Innovation is a fundamental core course that integrates ESG, environmental engineering, and social design, focusing on circular design, materials, and production systems. Students practice the entire process—from innovative material development to LCA analysis and product application—and evaluate the physical properties and design potential of eco-friendly materials like bioplastics and recycled fibers. They analyze changes in brands, policies, and consumption structures to propose future-oriented sustainable models. The resulting outcomes extend to materials reports, prototypes, and service planning.

· **Digital Fabrication (3)**

Digital Fabrication is a hands-on, hands-on course utilizing Fusion360, Rhino, Grasshopper, 3D printing, CNC, and laser cutting. It combines parametric design and manufacturing to achieve complex structures and lightweight designs. Through eco-friendly material printing and composite material simulation, students experience the entire development process—from design to prototype, material verification, and mass production review—building hybrid maker capabilities.

· **AI Modeling (3)**

AI modeling covers generative AI-based modeling techniques such as Diffusion, NeRF, and Text-to-3D. Students will learn image-to-3D
generation, texture and shape optimization, and simulation integration. Leveraging AI as a co-creator, students will explore and
combine multiple design options, building AI model libraries and interactive generative prototypes.

· **AI Renewable Design (3)**

AI Renewable Design is an advanced course that applies AI to renewable materials, upcycling, and circular manufacturing systems. It conducts material

mix prediction, module design, and LCA-based evaluations. This hands-on course integrates innovative material testing and manufacturing verification into an integrated project, connecting it to green tech, circular fashion, and architecture/furniture upcycling in industrial settings.

· **AI Entertainment Design (3)**

AI Entertainment Design is a practical course that utilizes generative AI to create virtual humans, costumes, XR performances, and 3D scenes. Students design digital performances, including AI styling, motion generation, and virtual fashion show implementation, and research IP monetization models and entertainment industry trends. The final product will be an AI fashion show, music video, or real-time avatar performance.

· **AI Design Studio (3)**

The AI Design Studio is a final project-based course that integrates the entire department's capabilities. It encompasses AI design, material experimentation, digital production, XR visualization, and business strategy, all under one full pipeline. Based on mentoring, students develop industrially applicable products and services, aiming to produce practical prototypes and marketable results.

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