Dept. of Forest Products and Biotechnology

Department of Forest Products and Biotechnology educates professional experts who will develop new technologies and lead industries with the scientific theory and knowledge for industrial applications of diverse biological resources from forests. Students learn basic science focused on wood, chemistry, biology, pulp, and paper.
Based on basic science learning, we conduct intensive practice and research in major fields such as bio-energy, bio-nano films, wood preservation, eco-friendly building materials, structural analysis of wooden buildings, composite materials, functional foods and drugs, and microbial application. In order to provide systematic studies, students are encouraged to choose their research topic with the relative classes among the laboratories of graduate studies. This program strengthens the ability to conduct professional research through a variety of academic activities and fosters core international experts.

☐ **Courses**

❑ **Forest Products and Biotechnology Major Courses**

· **Advanced 4th Industry Technology in Forest Products (3)**

Understanding of new converging technology in 4th industry technology, and application into forest products & biotechnology industry.

· Industrial Application for AI Technology **(3)**

Student will understand the data processing cases for the application of the fourth industrial revolution technology and artificial intelligence in the paper processing field.

· Understandings of AI **(3)**

Students will understand the concept of artificial intelligence, which is the basic technology of the 4th industrial revolution, and explore its applicability in the field of forest products and biotechnology.

· **Advanced Nuclear Magnetic Resonance Spectroscopy (3)**

NMR is a spectroscopic method that is even more important to the organic chemist than other spectroscopy. We can acquire many information about the number of magnetically distinct atoms of the type being studied. During the NMR study, we can acquire a structure about unknown compounds. It is very powerful method.

· **Independent Study (3)**

To study deeply, it is necessary for a student to meet his advisor regularly and then, discuss research challenges and solve the issues in a timely and proper fashion. This course meets these kinds of needs and provides a personal tutoring in research and development.

· **Advanced Biotechnology (3)**

Students will understand the biological characteristics of cells, genes, proteins, and metabolites in this class. They also study the process to produce biological products with industrial value based on their learning and introducing engineering.

· **Advanced Biochemistry (3)**

Biochemistry is the investigation of the molecular basis of life. Also, Tree biochemistry is too. Structure, dynamics, and the function of biological molecules in cells and organisms will be focused in this class. Metabolisms, formation, and properties of cells, membranes, organelles, and whole living bodies will be also covered.

· **Advanced Natural Products Chemistry (3)**

The study of natural products has always been the starting point of the discipline of chemistry in every country of the glove, and, in view of the importance of these organic compounds in agriculture, medicine, and industry, every student of chemistry today feels the need to acquire further knowledge in this field. Specially, we will deal with wood's structures, properties, natural sources, and synthesis with emphasis on biological activities of important natural products such as terpenoids, alkaloids, flavonoids, steroids, lignans, and other phenolic compounds as well as various essential oils will be introduced.

· **Advanced Environmental Microbiology (3)**

This class studies diverse research cases about the physiology, growth regulation, and

application of microorganisms that are important to forest ecosystems or used in forest product processing. In each case, the relationship between the biological characteristics of the microorganisms and forest ecology or forest product processing are reviewed in depth.

· **Advanced Instrumental Analysis (3)**

Before attempting to deduce the structure of an unknown organic substance from an examination of its spectra, we can simplify the problem somewhat by examining the molecular formula of the substance. The purpose of this lecture is to describe how the molecular formula of a compound is determined and how structural information may be obtained from that formula.

· Climate change and Environmental Process Technology **(3)**

It deals with multidisciplinary topics related to the area of environmental engineering technology such as biological greenhouse gas mitigation technology, bioenergy production, and biological environmental restoration technology related to climate change.

· **Advanced Nanofiber Application (3)**

This course introduces the technological application of nano-cellulosic fiber for the new materials such as thin-film products and papermaking additives using the woody and non-woody lignocellulosic materials and regenerated cellulose materials.

· **Advanced Green Environmental Materials (3)**

Based on the information for the physical, chemical, and mechanical characteristics of various natural fibers and polymer materials required in developing eco-friendly materials, the thermal, viscoelastic, acoustical, and surface-chemical properties of green composites will be investigated using analytical equipment.

· **Current Topics in Wood Polymer Science (3)**

This course considers macromolecular properties of wood.

· **Advanced Treatment Technology in Wood Protection (3)**

The diverse treatment technologies for wood protection from deterioration are introduced and students also learn the knowledge of the recent study.

· **Advanced Wood Protection (3)**

The biological mechanism of wood deterioration by insects and microbes will be introduced and students will learn the intensified theories which are required for preservation of wood from biological deterioration.

· **Advanced Wood Industry (3)**

This class deals with manufacturing theories and performances of various wood-based materials including wood-based composites (particleboard, fiberboard, plywood) and engineered wood (glued laminated timber, laminated veneer lumber, cross laminated timber). Additionally, specialized research areas needed in wood industries are reviewed in detail.

· **Advanced Wood Adhesion and Finishing (3)**

In adhesion part, mechanism of wood adhesion, types and characteristics of wood adhesives, factors of wood adhesion, testing methods and standards of bond performance, newer developments are treated in detail. In finishing part, characteristics and types of wood finishes, finishing and refinishing of wood finishes in solid woods and wood-based materials, effect of construction practices on finish durability, and prevention of failure or discoloration of finishes are treated extensively.

· **Wood Extractives Chemistry (3)**

Among wood species, differences of chemical structures of three major cell wall components, cellulose, hemicellulose, and lignin, are few. However, a great diversity in extractive composition is found throughout wood species. Although the extractives are low in concentration compared with those of the cell wall polymers, this fraction characterizes each wood species chemically. Most components of wood extractives are classified as secondary metabolites, and the distribution of specific compounds is restricted in certain wood species. This feature provides the basis of chemotaxonomy of woody plants. The purpose of this lecture is to understand how we can use a benefit of wood extractives that has many bio-activity.

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· **Advanced Wood-based Composites (3)**

This class studies the recent topics on wood-based composites such as particleboard, fiberboard, plywood, laminated veneer lumber, glued laminated timber, as well as wood-plastic composites, wood or non-wood lignocellulosic nano-composites. Also, adhesives and coatings used in manufacturing wood-based composites are reviewed.

· **Advanced Wood-based Biomaterials (3)**

This course is designed to provide the use of sustainable wood-based biomaterials and development guides for various new materials.

· **Wood Materials (3)**

The purpose of this lecture is to understand the fundamental principles of cellulose technology and presents current techniques to modifying the basic chemistry of lignocellulosic materials.

· **Advanced Wood-based Environmental Science (3)**

This course treats housing or building environments using various environmentally-friendly construction materials such as wood, wood-based materials, and wood-plastic composites, etc.

· **Metabolic Engineering (3)**

In this class, students will acquire knowledge that can be applied to study metabolites through cellular enzymes and their reactions associated with the primary metabolism and secondary metabolism of cells.

· **Microorgamisms and Industrial Application (3)**

Microorganisms are mainly used for industrial biotechnology. This course presents

the characteristics of microorganisms for industrial use by case studies. Students learn through comparative analysis of case studies, and have a chance to design new industrial applications of microorganisms. Students will learn how to use microorganisms creatively by presenting and discussing the designed applications.

· **Microbial Molecular Biology (3)**

This class gives better understanding of the advanced theories of molecular biology relating to life phenomenon, specifically on fungi and bacterium. Students will study the growth, evolution, behavior, regulation, and ecology of microorganisms at the molecular level using research technologies of DNA.

· **Current Topics in Wood-based Bionanomaterials (3)**

Current topics and applications of various biomaterials mostly using wood-based nano cellulose are introduced. After that, the applied technology concepts/methods are discussed and analyzed. As a result, the understanding for the bio-nano materials and related new technologies will be promoted.

· **Biomass Bioconversion Process (3)**

This class studies elementary technology to establish the platform production system by biocoversion process based on eco-friendly biomass. The class will emphasize to learn the key technologies including the biomass pretreatment, biocatalysis development,conversion process, fermentation, separation-purification, and use development technology.

· **Biomass Resources (3)**

This subject covers the global forest resources supplying for wood and energy industry. Especially, evaluation of timber and fuel feedstock, supply prospects and their potential from world forest resources are major focuses.

· **Research and Methodology for Bio-composites (3)**

In this course, various methods used in demonstrating, analyzing, and representing the data and results in performing bio-composites and related research are discussed and reviewed.

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

Topics include the introductions to various environmentally friendly biomaterials applications, related technologies, up-to-date research and industry trends. In addition, through presentations and discussions, the future and opportunities of eco-friendly biomaterials and areas where interdisciplinary convergence is possible are explored.

· Advanced Biohydrogen Energy **(3)**

Based on understanding biochemical and biophysical characteristics of cellular materials, students study the processes to produce high-value bio-products.

· **Bio numerical analysis (3)**

It deals with process prediction model development and numerical analysis techniques according to biomass characteristics to optimize the use of bio resources.

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

Presents and discusses the raw material property and manufacturing process of nano-cellulose, and the theoretical principles and applied technologies of thin film materials using the new technology of nano conversion and solutionization.

· **Advanced Bigdata Analysis (3)**

Big data analysis can be used to identify and solve scientific problems fundamentally. This course will teach how to draw conclusions through the collection and processing of big data for scientific research. The course present scientific research method through case studies.

· Bioconversion for Forest Resources **(3)**

Protein is the essential molecules for production of many bio-functional materials. This class emphasizes the characteristics of protein and introduces the methods for improving the activity of protein and for producing the protein efficiently.

· Biodeterioration of Biomaterials **(3)**

Students study the biodeterioration of wood caused by microbes and its characteristics, especially by exploring the wood deterioration research on most

common wood deterioration microbes.

· **Microbiome in Eco-system (3)**

Microorganisms are the basic living organisms that make up an ecosystem. The overall microbial ecology rather than individualmicrobes determines our health and environment. In this course, students will learn specialized knowledge focusing on research methods in the microbiome, a microbial ecology, and scientific methods to improve the distribution of microbiota in microbiome.

· **Advanced Fiber Recovery and Deinking (3)**

The course covers the fiber chemistry and recycling of waste paper. Lecture forcuses on the properties of virgin and secondary fibers, re-pulping of waste paper, removal of deinked particles, bleaching of deinked pulps, and deinking process.

· **Advanced Cell Biology (3)**

This class studies the structure and the function of cells and discusses the mutual relation between these two aspects in cells.

· **Advanced cellulose fibrous materials (3)**

Advanced Pulping Science provides the technological and chemical consideration of pulping of raw materials used in the paper industry. Includes advanced consideration of the pulping and bleaching processes, related chemistry, and discussions of related operations, e.g., chemical recovery.

· **Advanced New and Renewable Energy Science (3)**

This subject deals with the new and renewable energy that is needed for implementing the United Nations Framework Convention on Climate Change(UNFCCC) and reducing greenhouse gases. It will focus on all aspects of this particular renewable energy source—its availability, expanded support policy, economics, environmental effects, and practicality.

· **Experimental Design (3)**

Understanding of the basic concepts of statistics and important principles of experimental design is essential for research. The class studies regression, correlation, and dispersion

analysis intesively in order to efficiently use computer programs and to understand and analyze their outputs.

- **Energy Biotechnology (3)**

  This class studies biofuel industry using biotechnology as an alternative way of energy supply for responses to climate change. The class will address the technologies related to sustainable bio-energy from lignocellulosic feedstock supply to successful biofuel anaerobic digestion.

- **Research Ethics & Dissertation Study (3)**

  Instruct specific areas including the theme selection, experimentation, framing of a dissertation, and research ethics. It will cover the identification of the research problem, problem solving approaches, literature survey, and thesis formats. This course will also provide opportunity to become involved in graduate research, under guidance of a supervisor, on a problem of mutual interest to student and supervisor.

- **Regulation of Gene Expression (3)**

  The gene expression is the critical beginning process for life. This class studies the function and the regulatory system of DNA region for gene expression and makes mutations in bacteria for practical studies.

- **Seminar in Wood Engineering (3)**

  Presents and discusses theoretical and technological investigation of the wood -based material and engineering.

- **Field Trip of Forest Products Technology (3)**

  Practice by field trip in the industrial site, public institution, national agency, etc. related on the forest products & biotechnology.

- **Seminar in Forest Products Industry (3)**

  Understanding of current topics in the industry fields of forest products and biotechnology by inviting an outside expert.

- **Laboratory Statistics in Forest Products (3)**

Understanding of laboratory statistical analysis for the scientific research. Collection, analysis, and interpretation of scientific data for the research and utilization of natural resources will be introduced and practiced.

· **Advanced standardization in forest products industry (3)**

A standard is a repeatable, harmonised, agreed and documented way of doing something, and Standardization is the process of developing, promoting and possibly mandating standards-based and compatible technologies and processes within a given industry. This class studies the standards in Forest products industry, and the specialized knowledge for national and international standardization process.

· **Seminar in Wood Chemistry (3)**

The purpose of this seminar is to understand a trend of all about wood chemistry. For example, spectroscopy, organic chemistry, tree biochemistry, wood extractives chemistry and wood polymer science. After studying this lecture, we hope that students will understand all about wood chemistry.

· **Advanced Papermaking Process & Smart Factory (3)**

This course introduces the principle and structure of pulp and paper machinery. The fundamental subjects are focused on the technical understanding of recent paper machinery and the application of smart factory.

· **Advanced Paper Mill Modeling (3)**

The course covers the practical understanding of precess control in the pulp and paper industry. The objectives of topic are the introduction of chemical engineering controls in papermaking process, prosess instrumentaion, process dynamics, and the fundamental unit operation and mass and energy transfer concepts.

· Hazardous Paper Chemicals Analysis **(3)**

Introduction to solid and hazardous waste regulations. Analysis and design of solid and hazardous waste management systems, including generation, storage, transport, recycling, biological, physical, chemical and thermal treatment; energy recovery; land disposal; environmental protection systems and monitoring.

· **Advanced Papermaking Chemistry (3)**

This course introduces the practical aspects of water, treatment methods of fresh water, white water and effluents. The relevant operations include the physical, chemical and biological operations, the environmental analysis factors, and furthermore the process designs for zero-effluents.

· **Advanced Paper Environmental Analysis & Seminar (3)**

Advanced Paper Environmental Analysis & Seminar introduces the topics of physical, chemical and environmental parameters in paper making process and recycling of waste paper as well as water and waste water treatment. Includes discussions and presentations in advanced topics on paper environmental analysis.

· **Advanced Paper Conservation (3)**

The course introduces various aging behaviors and principles of paper by acidification, thermal degradation, moist heat treatment, and structural mechanism of paper for understanding the conservation treatment and systematic approach of aging.

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

Understanding of raw materials, process and current industrial application for special use as a natural new materials.

· **Advanced Analysis of Paper Heritage (3)**

Introduction to physical, chemical theories and properties of record & painting materials. Advanced science courses in cellulosic fibers, inorganic additives, deterioration behaviors and analysis methods, deacidfication and special treatment for paper conservation.

· Advanced Sustainable Polymer **(3)**

Wood is a natural composite material which consists of three main macromolecular components: cellulose, hemicellulose, and lignin. These natural polymers are built up by repetitive bonding together of many smaller molecules. Cellulose and hemicellulose, for example, are polymers built of repeating sugar units: lignin is a polymer formed by the enzymatic dehydrogenation of phenyl-propanes followed by radical coupling. In this lecture, the three main polymer components of wood are identified and then, general and advanced applications of the polymer materials are

discussed from various properties and characteristics perspectives.

· **Topics in Natural Products Chemistry (3)**

The study of natural products has always been the starting point of the discipline of chemistry in every country of the glove, and, in view of the importance of these organic compounds in agriculture, medicine, and industry, every student of chemistry today feels the need to acquire further knowledge in this field. Specially, we will deal with wood's structures, properties, natural sources, and synthesis with emphasis on biological activities of important natural products such as terpenoids, alkaloids, flavonoids, steroids, lignans, and other phenolic compounds as well as various essential oils will be introduced.

· **New Approaches for Biotechnology (3)**

New cutting-edge technologies are introduced continuously in life science. This class studies the principles of these new technologies and discusses their application on research.

· **Advanced Technology of Paper Finishing (3)**

Understanding of paper finishing technology such as surface sizing, calendaring, and coating for the purpose of functionality of paper, and additional paper modification of base paper.

· Carbon Neutral Physiology **(3)**

It deals with recent topics considering both greenhouse gas reduction and climate change adaptation such as activation of wood utilization with high carbon uptake and forest restoration in order to strengthen the carbon uptake function using forest ecological resource-based solutions and expand the low-carbon production in related industries.

· Advanced Carbon Neutral Policy **(3)**

Students will understand national and global carbon-neutral response strategies for climate change, suggest carbon-zero policy directions in the forest biotechnology industry, and increase understanding of policy implementation by seminar with field experts.

· **Soil Microbial Ecology and Restoration Science (3)**

This course explores the functions and structures of microbial ecosystems in soil, focusing on acquiring scientific knowledge and practical applications to contribute to environmental restoration and ecosystem sustainability. Soil microbes play a critical role in maintaining and restoring the environment through processes such as organic matter decomposition, nutrient cycling, and pollutant removal. Students will gain an in-depth understanding of the diversity and functional roles of these microbial communities in soil. The course covers the ecological characteristics of soil microbes and the effects of various environmental factors on microbial communities. It also discusses the application of soil microbes as a strategy for ecosystem restoration. Special emphasis is placed on restoration techniques using microbes in environments where soil microbial ecosystems have been disrupted by landslides, the impact of microbial community structure changes on the environment, and the latest research and technologies for restoring microbial ecosystems.

· **Current Topics in Instrumental Analysis (3)**

Before attempting to deduce the structure of an unknown organic substance from an examination of its spectra, we can simplify the problem somewhat by examining the molecular formula of the substance. The purpose of this lecture is to describe how the molecular formula of a compound is determined and how structural information may be obtained from that formula. Many of methods are still in routine use today, but the use of mass spectrometry has become a common alternative. So it will be also covered more weightly.

· **Enzyme Engineering (3)**

The class introduces the expertise and the latest research trends in the theory and application of enzymes which are used in the biological conversion of biomass for the production of high value products.

☐ Faculty Members

Kim, Birm June
Kookmin Univ., B.S.
Seoul National Univ., M.S.
Louisiana State Univ., Ph.D.
Green Composites / Biomaterials
bjkim3@kookmin.ac.kr

Kim, Hyoung Jin
Kangwon National Univ., B.S.
Kangwon National Univ., M.S.
Univ. of Manchester Institute of Science & Technology Ph.D.
Paper Science / Environmental Analysis
hyjikim@kookmin.ac.kr

Lee, Tai-ju
Kookmin Univ., B.S.
Kookmin Univ., M.S.
Kookmin Univ. Ph.D.
Paper / Cellulose advanced materials
leetj@kookmin.ac.kr

Kim, Tae-Jong
Korea University, B.A.
Korea Advanced Institute of Science and Technology, M.S.
University of California at Davis. Ph.D.
Natural Resources and Biology
bigbell@kookmin.ac.kr

Yun, Jeonghee
Kookmin Univ., B.S.
Univ. of Idaho, M.S.
Ewha Womans Univ., Ph.D.
Bioenergy and Environmental Processes
yunjh@kookmin.ac.kr