

Dept. of Forest Products and Biotechnology

Forests are an important part of the ecosystem and have many biological resources. In order to maintain ecosystem and our environment, we need to be better managed and used than to leave the forest untouched. The graduate program in Department of Forest Products and Biotechnology offers advanced programs in the utilization of eco-friendly materials, bio-based chemicals, and sustainable bioenergy which are from the forest through the foundations of engineering and biology. Through advanced engineering and biology basics, experiments using cutting-edge .new technologies, and industrial applications, our program creates scientists who work in all field, starting with forest products.

Courses

Forest Products and Biotechnology Major Courses

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

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

- **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.

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

Presents and discusses the theoretical and technological investigation of the forest science, and forest products science and engineering.

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

The main topic of class is the 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.

- **Experimental Design (3)**

An 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 intensively in order to efficiently use computer programs and to understand and analyze their outputs.

- **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.

- **Advanced Wood Physics (3)**

Specific gravity and moisture content variation affecting the physical properties, and movement of water at the fiber and wood will be discussed. And wood in relation to heat, etc. will be also discussed.

- **Advanced Timber Design & Mechanics (3)**

Selected problems will be outlined in the field of design procedures for the glued laminated members, panel products and built-up members. Elastic theory for the stiffness and strength, and buckling resistance of composites will be discussed.

- **Advanced Wood Mechanics (3)**

This course deals with the wood as an engineering materials affecting design of wooden members. Emphases are on the stress-strain relations for non-isotropic materials, influence of density, defects, and glued laminated constructions.

- **Advanced Engineered Wood (3)**

Recent topics on engineered woods such as specialty plywood, particleboard, fiberboard, glued laminated wood, laminated veneer lumber, and newer developments such as laminated or oriented strand lumber, laminated veneer board, triboard, and wood-nonwood composite are reviewed in detail.

- **Microtechnique and Wood Identification (3)**

Basic techniques of sample preparation, result interpretation, skillful use of microscope, etc. for light and electron microscopies needed in wood anatomy and identification are treated in advance. And, wood identification procedures based on macroscopic, microscopic, and ultramicroscopic features of commercially important domestic and imported woods are discussed in detail. Laboratory work is essential.

- **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.

- **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 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.

- **Microbiology in Wood Deterioration (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.

- **Insects in Wood Deterioration (3)**

Students study the biodeterioration of wood caused by insects and its characteristics, especially by intensified studies on insects and their characteristic damage according to environmental and regional variation.

- **Advanced Wood Deterioration in Wooden Cultural Properties (3)**

This subject manages advanced theories centered specifically on the causes of occurrence and detailed damage properties for wooden structures and landscape components etc. by wood decaying fungi and insects.

- **Advanced Conservation Science and Technology in Wooden Cultural Properties (3)**

This subject covers related theories and technologies in the area of conservation & restoration of wooden and paper cultural heritage. Key focus of conservation science is studying the biodegradation or deterioration mechanism of objects, effective inspection as well as maintenance technologies.

- **Repair and Maintenance Technology in Wooden Cultural Properties (3)**

This subject covers the conservation-restoration treatments for the continuance of wooden cultural heritage to exist in its best condition possible, regardless of age and degradation.

- **Plant Quarantine (3)**

This subject gives the advanced theories in the area of biological pest control or chemical treatment, that are used to prevent the introduction of organisms such as insect pests which could generate from the increase of regional and national trade quantity.

- **Advanced Bioenergy Science and Technology (3)**

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

- **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.

- **Current Topics in Biomass Pretreatment (3)**

Cellulosic materials are particularly attractive as feedstocks for biofuel or biochemicals production because of their relatively low cost, great abundance, and supply sustainment. However, lignocellulosic biomass, such as the woody plant, contains polymers of cellulose, hemicellulose, and lignin bound together in a complex structure, which is recalcitrant for liberating each component. This subject covers for the pre-treatment technologies for separating each component of the lignocellulosic biomass, emphasizing concepts as well as understanding the mechanism of action and practicability.

- **Current Topics in Wooden Biomass Energy (3)**

This subject deals with the current topics in wooden biomass energy. Especially, researches on converting and processing of wood biomass into biofuels or other value-added products that are recently presented at professional journals are mainly discussed.

- **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.

- **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.

- **Biomass Fermentation Technology (3)**

Students will learn the fermentation characteristics and the process of carbohydrate obtained through the biomass component separation. The class will emphasize to learn the details of fermentation process including the relationship between the fermentation and pretreatment and saccharification process of biomass.

- **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 globe, 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.

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

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- **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.

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- **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.

- **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.

- **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.

- **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.

- **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.

- **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.

- **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.

- **Advanced 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.

- **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 Physics & Converting (3)**

This course gives an understanding and application of the physical and mechanical properties of paper, and various converting processes and end-use requirements involved in the manufacture of commodity and specialty products. The main converting processes are coating, calendaring, super calendaring, printing, and the manufacture of corrugated board.

- **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 Water Treatment in Paper Processes (3)**

Topic includes the introduction to physical, chemical and biological parameters

of water and wastewater quality as well as principles of unit operations and processes for water and wastewater treatment. Discussion of zero-effluents design for papermaking process.

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

The course covers the fiber chemistry and recycling of waste paper. Lecture focuses 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 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.

- **Advanced Pulping Science (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 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 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.

- **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.

- **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.

- **Advanced Protein Engineering (3)**

Protein is the essential molecules for production of bio-products. This class introduces the methods for improving the function of protein and for producing the protein efficiently by emphasizing the characteristics of proteins.

- **Advanced Microbiology (3)**

This class studies the physiology, the growth, and the application of microorganism with case studies. Case studies will provide the bottom-line principles of microbiology in application.

- **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 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.

- **Microorganisms 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.

- **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.

- **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.

- **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.

- **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.

- **Advanced Wood-based Polymer Science (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.

- **Wood Polymer Science (3)**

This course considers macromolecular properties of wood.

- **Advanced Wood & Water Relationship (3)**

Specific gravity and moisture content variation affecting the physical properties, and movement of water at the fiber and wood will be discussed. And wood in relation to heat, etc. will be also discussed.

- **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.

- **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 Paper Modification (3)**

The course covers the internal and surface sizing, calendaring, coating for the purpose of functional ability of paper and additional special treatment through the paper modification of base paper. Lecture also includes the theoretical background and special applicable field in paper modification.

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

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

- **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, deacidification and special treatment for paper conservation.

- **Advanced Hazardous Paper Chemical 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 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.

□ **Faculty Members**

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