Department of Biological Science and Biotechnology

1. Educational Goal

To foster excellent Scientists and professionals in Biological Science and Biotechnology

2. Educational Objective

To produce discoveries that contribute to Biological knowledge, to develop practical applications that affect human lives, and to provide superior training for the future Scientists. The training we provide allows graduate students to begin careers that contribute to the world in research, teaching, industry, and government service.

3. List of Full-time Faculty

Name	Position	Degree (University)	Field of Instruction	Area of Research
Sim, Chung Ja	Emeritus Professor	Ewha Univ.	Animal Taxonomy	Animal Taxonomy
Ko, Sung Chul	Emeritus Professor	Korea Univ.	Plant Taxonomy	Plant taxonomy
Park, Jin Suk	Professor	Hannam Univ.	Microbial Taxonomy & Ecology	Microbial taxonomy & Ecology
Park, Kyung Ryang	Professor	Korea Univ.	Environmental Microbial Physlology	Environmental microbiology & Microbial physiology
Byun, Bong Kyu	Assistant professor	Kangwon Univ.	Animal Taxonomy	Entomological taxonomy
Choi, Soon Yung	Professor	Korea Univ.	Molecular Genetics	Molecular genetics
Hahn, kyu Woong	Professor	Yonsei Univ.	Molecular Biology of the Cell & Plant Physlology	Plant Physiology
Chung, Hye Shin	Professor	Purdue Univ.	Biochemistry	Biochemistry & Protein pharmaceuticals
Kim, Young Min	Professor	Göttingen Univ.	Genetics	Molecular genetics
Lee, Jin A	Associate professor	Seoul National Univ.	Molecular Biology of the Cell & Neuroscience	Neurobiology
Jeong, Sung Eun	Professor	Hannam Univ.	Animal Physiology	Physiological biochemistry & Molecular biology
Lee, In Soo	Professor	Hannam Univ.	Molecular Biology	Soil microbiology & Molecular biology
Kim, In Seop	Professor	Seoul National Univ.	Biotechnology	Applied microbiology & Biotechnology
Kim, Myoung Kwan	Assistant professor	Soongsil Univ.	Management of Technology	Management of Technology, Technology Marketing, Industrial Policy

Yoo, Je-Geun	Associate Professor	Univ. Goettingen	Purification of Recombinant Protein	Genetic Engineering of Microorganisms

4. Course Description

BB601 Advanced Molecular Biology 3 credits

This is a very important basic lecture in current biological sciences. It deals with the life at a molecular level. It focuses DNA as the genetic material, structure and characterization of proteins, the understanding of central dogma as DNA replication, transcription, translation, and DNA repair, including the regulatory mechanism of gene expression.

BB602 Molecular Biology of the Cell 3 credits

Our life is composed of many cells. To understand various biological functions of the cell, this course will cover cellular structure, cytogenetics, differentiation, and regulation in relation to their functions. Recent advances in cellular biology and technology will be also discussed.

BB603 Cellular signal transduction 3 credits

Signal transduction at the cellular level refers to the movement of signals from outside the cell to inside and it involves the coupling of ligand-receptor interactions to many intracellular events. These events include phosphorylations by tyrosine kinases and/or serine/threonine kinases. Protein phosphorylations change enzyme activities and protein conformations. The eventual outcome is an alteration in cellular activity and changes in the program of genes expressed within the responding. This course will provide better understanding of cell-cell communication.

BB604 Advanced Biochemistry 3 credits

Biochemistry deals with the chemical characteristics, metabolism and interactions of the bio-molecules which are not only consisting the organism themselves, but also participating in governing their living activities. This advanced subject expects the students preliminarily equipped with some preliminary knowledge on the structures, reactional characteristics and biological functions of the major molecules, carbohydrates, lipids, proteins and nucleic acids, and pursues figuring out the major research trends as well as the experimental methodologies by studying, analyzing and discussing the current biochemical literatures and topics.

BB605 Numerical Taxonomy 3 credits

This course helps you carry out cladistic and clustering analyses based on the evolutionary trends of taxonomical characters using various computer programs. And so, you can illustrate relationship between the treated taxa numerically.

BB606 Seminar 1 1 credits

This course is mainly focused on presentations and discussions about understanding literatures related to topics of theses, planing researches of theses, and trends and results of researches along with Seminar 2 to improve research abilities and develop expression abilities.

BB607 Seminar 2 1 credits

The goal of this course is to improve analysis abilities of results of researches and develop discussion abilities while presenting understandings about literatures related to topics of theses and

results of researches related to theses along with Seminar 1.

BB608 Advanced Immunology 3 credits

This subject provides the understanding of the concepts for the principles of immune system. The nature and characteristics of immune system and of antibody will be discussed. The expression pattern of antibody genes, the recognition of foreign materials, and the other topics related on immune will also be included.

BB609 Advanced Genetics 3 credits

Genetics is the subject to study about the hereditary transmission of genetic material and its mutation in biological organisms. With this course, students will understand the molecular mechanism of genetic transmission, variation, and evolution. This course also will use articles from both textbooks and the primary literature to familiarize you with the historical foundations of modern genetics and with the use of genetic and mathematic methodology, and reasoning in the dissection of complex biological systems. By studying genetic mechanisms from many different systems, the students will learn to focus on the genetic methods and reasoning regardless of the system to which they are applied.

BB610 Topics in Cell & Tissule Culture 3 credits

This subject provides an overview on the cell & tissue culture which is one of the important technique of biotechnology. When the foreign gene derived from animal or plant is introduced into prokaryotic system, the structure of produced proteins is somewhat different from its native form. So the direct cell & tissue culture method using animal or plant to be found a very useful technique. The fundamental principles and necessary techniques used in cell & tissue culture will be discussed.

BB611 Advanced Proteomics 3 credits

Recent development in analytical methods for protein characterization, and the growing rate at which whole genome sequencing projects are being completed, have combined to support the emergence and development of the new field of proteomics. Proteomics, the study of protein expression and function on a genome scales, is the amalgamation of very many differnet experimental approaches ranging from the analysis of gene function by mRNA expression profiling with cDNA arrays, analysis of protein:protein interactions by genome-wide two hybrid screening, to more directed analysis of protein expression, sequence and structure. In this course, basic principles and tools for proteomics will be lectured.

BB612 The Natural History Museum 3 credits

The one way of solution for the biodiversity reduction and environmental crisis in now is to build natural history museum and run it actively. The Research (inner museum) and Public service(outer museum)-education and exhibition- through museum activities is the very important role for the management of our nature hereditament and nature protecting enlightenment. According to the increasing trend of the necessity of natural history museum recently, Several regions in Korea are also eager to open the museum fortunately. To manage the museum actively, It is need for many curators or special exports absolutely. This lecture have the contents for being curators about the functions, visions, and roles on natural history museum and etc.

BB701 Advanced Seminar 1 1 credits

This course is mainly focused on presentations and discussions about understanding literatures related to topics of theses, planing researches of theses, and trends and results of researches along with Advanced Seminar 2 to improve research abilities and develop expression abilities.

BB702 Advanced Seminar 2 1 credits

This course is for the Doctoral course students to improve analysis abilities of results of researches and develop discussion abilities while presenting understandings about literatures related to topics of theses and results of researches related to theses along with Advanced Seminar 1.

◆ **Ecological Course**

BB613 Advanced Insect Morphology 3 credits

Insects are known as the most successful group in the animal kingdom. In this course, we study the morphology of insects to understand the phenomenal success of this class of arthropods. The diversity of insect taxa are matched by a large variation of modifications in its body structure. These modifications enable insects to occupy nearly all ecological niche and habitats and to utilize a variety of food resources. In this subject, we study and examine the insect morphology for understanding of how their own bodies with various structures and functions.

BB614 Advanced Plant Anatomy 3 credits

This course helps you understand the problems of differentiation, maturation and organization at level of cells, tissues and organs for seed plants. You will recognize the significance of plant anatomy among the plant sciences after this course.

BB615 Advanced Molecular Systematics 3 credits

To characterize the diverse microorganisms systematically, we have to analyze the phenotypic properties and phylogenetic similarity of common ancesters shared by them. This course will deal with the advanced aspect of theoretical background and analytic methods of microbial systematics, with attention to phylogenetics, chemotaxonomy, numerical taxonomy, and cladistics.

BB616 Advanced Plant Ecology 3 credits

This course provides broad knowledges to forest ecology. The course focus is methods used to understand species interactions in plant communities and relationship of these communities to environmental factors.

BB617 Advanced Population Ecology 3 credits

Population ecology is a major topic of ecology, dealing with the population dynamics and the populations interaction with the environment. In this topic, we study the population sizes, seasonal fluctuation, life table of species, and so on. Population ecology is important in conservation biology and pest management, which makes it possible to predict the population movement relating with the environment.

BB618 Advanced Microbial Ecology 3 credits

The dynamics of microbial community, kinds of microorganisms in several habitats and biochemical changes are considered in this course by examining various current topics including community change, organization, biodiversity, energy flow and nutrient cycles.

BB619 Topics on Insect Resources 3 credits

Recently, our interest is concentrated into the insect resources, which is one of the most diverse biological resources in the natural ecosystem. The main topics of this course is to get knowledge of the major group of beneficial insects, including possible taxa, and the technology development for searching for useful insects with its application. Also, we will discuss about the category of insect resources, main taxa, evaluation, and mass production technique for developing the insect resources.

BB620 Advanced Microbial Metabolism 3 credits

In this course you will learn overall flow of how energy and organic materials which are supplied from natural resources can be used by microorganisms to live on. You will also learn how to manage microorganism resource, how to control microorganism, and how to search new products from microorganism. Thus you will be able to apply these to practical life systematically.

BB621 Animal Taxonomy 1 3 credits

Inquire relationship lands and ocean, invertebrate live in fresh water and environment, the whole invertebrate it established systematics phylogeny and it lectures relationship and a distribution with it probably is a biosdiversity, there is a place objective. Each phylum of invertebrate structure, physiology, classification, reproduction, develoment and phylogenetic position considered it studied understanding diversity of invertebrate, biodiversity conservation problem examined environment problem.

BB622 Animal Taxonomy 2 3 credits

It classifies scientifically phylogeny of the vertebrate and it studies the relationship and related with environment each other. Each phylum of vertebrate classified, also it's classified structure, physiology, reproduction, reproduction, develoment and phylogeny and it studies difference of invertebrate so that we take cognizance of diversity of animal.

BB623Advanced Animal Evolution 3 credits

As the evolution is that as theoretical general learning of all fields of biology, for a long time, all field of biology through experiment and theoretical data abundant experience accomplishes and there is a place objective which recognizes the importance of the evolution which is a fusion science of the biology which it puts.

BB624 Plant Taxonomy 1 3 credits

This course provides a broad introduction to taxonomy of nonvascular plants such as lichens, algae, bryophytes and so on. The aim of this course is to let you understand their unity and diversity through life cycles and taxonomical characters.

BB625 Plant Taxonomy 2 3 credits

This course provides a broad introduction to taxonomy of vascular plants such as pteridophytes, gymnosperms and angiosperms. It helps you understand their taxonomical characters, their distributions, their relationships, and the existing taxonomical systems.

BB626 Plant Geography 3 credits

This course provides a broad introduction to the ecological evolution of flowering plants including their origin and expansion, and floristic regions of the world according to ecological gradients.

BB627 Advanced Palynology 3 credits

This course provides various informations to evolutionary trends of morphological, anatomical, cytological, palynological and chemical characters in seed plants. It will raise your ability to understand various taxonomic schemes.

BB628 Advanced Marine Microbiology 3 credits

This course will deal with relationships between microorganisms and physical, chemical, and biological factors of the marine environment, focussing on microbial community, ecological roles in biochemical processes, and human impacts.

BB629 Advanced Environmental Microbiology 3 credits

This course will enable you apply your understandings to environmental industry which uses microorganisms to environmental pollution to purify it. In this course, you will learn such as ; roles of microorganisms as primary producer which are the foundation of all life forms, roles and significances of microorganisms related to biogeochemical cycling of elements, organic matter degrading activities and pathways of microorganisms, procedure to purify environmental pollution materials of soil, water, and air using microorganisms which have organic matter degrading activities, roles of microorganisms in disposing waste water and solid waste, methods to estimate the level of environmental pollution using microorganisms, roles of microorganisms as a pathogens and indicating organisms, blooms which occurs due to microorganisms, and methods to remove environmental pollutions such as acid mine drainage and heavy metals.

BB630 Environmental Pollution Analysis 3 credits

Environmental pollution analysis explain a grim picture on levels of pollution and important modern methods of analysis. In other words, this course is to understand the toxic pollutants and their analysis, air pollution, water pollution analysis and chemical treatment. Also, on industrial effluents as well as domestic effluents from the recyclability viewpoint are explained in detail as well as soil pollution, noise and odor pollution.

BB703 Advanced Insect Phylogeny 3 credits

There are over 1 million described insect species in the earth. Insects can be found anywhere from water to land, and swamps to mountain areas. This class is designed to teach students about insect systematics, relationships, and phylogeny, which is the subdiscipline of biology that documents the diversity of living things. In this course, a variety of methodologies, including phenetics, cladistics, and the other useful theories, will be discussed to understand the insect diversity and phylogeny.

BB704 Advanced Systematic Botany 3 credits

For angiosperms, this subject at first improves student's ability to comprehend previous taxonomic systems such as Engler's, Bessey's. Tippo's and Cronquist's ones, etc. through understanding evolutionary tendencies of taxonomic characters, and finally helps student to establish a new taxonomic scheme by using cladistic and clustering analyses.

BB705 Advanced Molecular Evolution 3 credits

Advanced molecular evolution deals with systematic specialization and evolution of organisms through the comparison of composition materials of organisms within the viewpoint of molecular biology.

BB706 Special Topics in Marine Bioresource & Technology 3 credits

This course is designed to increase graduate students appreciation for marine bioresources with attention to their application in biotechnology.

BB707 Environmental biotechnology 3 credits

This course is mainly focused on understanding physiological mechanisms and roles of organisms which maintains environment of earth, and learning how to use organisms which live in different environments respectively to human life.

BB708 Anaerobic Microbiology 3 credits

In this course you will learn about diversity and dispersion of microorganisms which live in anaerobic environment covering most of earth environment. You will also learn various newest methods to use these microorganisms to improve human life.

BB709Advanced Extream Environmental Microbiology 3 credits

Microorganisms which live in extreme environment such as a high temperature and a low temperature, acidic and alkalic environment, heavy metal pollution, hypertonic and hypotonic environment, and anaerobic environment have specific mechanisms for their survival. And these specific survival mechanisms can be applied to human life in various methods. Hence, this course will give you ideas about specific survival mechanisms of microorganisms which live in extreme environment and let you use these specific survival mechanisms to hume life efficiently.

BB710 Advanced Topics in Current Microbiology 3 credits

In-depth discussion of current microbiologically relevant topics, including diversity, physiology, molecular biology, ecology and biotechnology, and introduction of various approaches in current microbial methodology.

◆ Biomedical Course

BB631 Advanced Developmental Biology of Animal 3 credits

Embryonic development is in very proper process to each of the major distinct animal groups exhibiting different morpho-physiological appearances to each other, revealing each of their evolutional histories. This subject deals with the general and specific principles in differentiation and specialization of blastoderms, tissues and organs, which rule in animal embryonic development by comparisons between some major animal groups.

BB632 Advanced Plant Physlology 3 credits

Plant physiology is a branch of biology that provides the understanding of the phenomena revealed by plants. This course will provide the concepts for the principles of: 1) water relationships, 2) material and energy metabolisms, 3) plant growth regulators, and 4) various environmental factors and stresses that affect the life of plants.

BB633 Advanced Human Genetics 3 credits

Through this course, you will be helped at a molecular level the knowledge about the inheritance and genetic disease that a trait and character of human can be delivered from an ancestor to a progeny, that is to say, human genomic repetitive DNA, mapping the human genome, identifying of kinship and a criminal, a test of chromosome, diagnosis of genetic disease, current genetic trend and application of future using molecular biology.

BB634 Advanced Molecular Genetics 3 credits

It contains genetic principles at a molecular level, including organization and expression of the human genome, human gene families and repetitive DNA, mutation and instability of human DNA, mapping the human genome, identifying human disease genes, genetic testing in individuals and populations, and genetics of cancer and immunology.

BB635 Advanced Genetic Engineering 3 credits

The purpose of this course is to introduce students to molecular concepts and techniques used in the fields of genetic engineering, which can be used in basic molecular biology and applications such as biotechnology. With basic understanding of the structure and function of cells, this course focuses on (1) function of several enzymes used in recombinant DNA, (2) genetic characterization of host and cloning vectors, (3) How to do cloning, (4) eukaryotic gene cloning, and (5) industrial applications. Student graduate with the ability to design the genetic experiment and make an oral and written report addressing a major topic or application in molecular biology.

BB636 Advanced Enzymology 3 credits

This subject emphasize the understanding of biological catalyst, enzyme. The structure and characteristics of enzyme, and kinetics of enzymatic reaction will be discussed. The apply of enzymes to the medical science and to the food science will also be included.

BB637 Advanced Reproductive Molecular Biology 3 credits

This is a very important basic lecture in current reproductive biology as well as molecular biology. It deals with reproductive system of human at a molecular level including cell signaling pathway. It focuses the determination of sex, development from fertilization to child birth, reproduction of sperm and eggs, gametogenesis of sperm and eggs, male and female reproductive system, and assisted reproductive technologies (ART) for infertility problems etc.

BB638 Neuroscience 3 credits

The goal of this course is to provide an introduction to basic and fundamental concepts in the field of neuroscience. This course gives students overviews of neuroscience including neuronal cell types, neurotransmission, ion channel, neuroanatomy, sensory and motor systems, brain regulation of behavior and body physiology, and neural development.

BB639 Medical Biotechnology 3 credits

Biotechnology encompasses the variety of methods available for manipulating living cells and organisms. Our recent advances of biotechnology in medical sciencehelp us to understand, treat, and cure human diseases. In this course, biotechnology in medical science will be reviewed. These

include genetics, epigeneticis, proteomics, metabolitics, vaccines, transgenic method, gene therapy, and stem cell engineering.

BB640 Methods in protein research 3 credits

This course is a comprehensive study of chemistry of amino acids, peptides and proteins. Structure, purification and analysis of proteins are given. Protein structure-function relationship and its application in biotechnology and drug design will be covered. Effects of site-specific mutations in proteins on the structure and function of proteins are considered. Topics may also include structure and chemical properties of specific domains of functional proteins such as DNA binding domains, transmembrane domains, or sites in signal transduction.

BB641 Biopharmaceutical Research 3 credits

Understandings on the biopharmaceutical research and development are important in biomedical sciences. Biopharmaceuticals in market are studied and making use of drug targets, procedures in development of biodrugs are covered. Case studies are presented by students.

BB642 Advanced Plant Molecular Biology 3 credits

In ecosystem, various genes of plants give rise to the diversity of plants. This subject helps students to apprehend genetic variations in accordance with the environmental changes in molecular and population levels, and to understand that the evolutionary motive in plant ecosystem is derived from the genetic variation of gene pool within plant populations

BB643 Topics in Plant Growth Regulation 3 credits

This subject covers a range of topics related on: 1) the characteristics of plant growth regulators, 2) the mode of action of plant growth regulators on the plant developmental processes, and 3) the nature and characteristics of the receptors that plays a important role in the signal transduction pathway. The concepts of differentiation and dedifferentiation will also be discussed.

BB644 Physiology of Plant Stress Responses 3 credits

Stress is usually defined as an external factor that exerts a disadvantageous influence on the plant. This subject discusses a range of topics related on: 1) the concept of stress tolerance and acclimation, 2) the morphological changes, 3) the cellular responses, 4) the mechanisms of acclimation through altering various metabolic pathways, and 5) the molecular responses that recognize stress signals and induce the tolerance in plants under adverse environment.

BB645 Advanced Microbial Genetics 3 credits

Microbial genetics provided basic ideas and genetic methodologies to the development of modern molecular genetics, which is rapidly under progression. From this course, students develop a concept of gene structure, and become better acquainted with gene replication and protein synthesis. They also understand how prokaryotic cells exchange genetic materials by recombinations. With the process of stimulating in-depth thinking and questioning, this course focus on the gene regulation, genetic mutations, and experimental approach to gene tagging.

BB711 Advanced Endocrinology 3 credits

It contains mainly the human endocrine system. It deals with the influence on human physiology, the relationship between hormones and cellular signaling pathway, the relationship between

hormones and nervous systems, the relationship between hormones and tumor reproduction as well as secretion and regulation of hormones, which are made from the hypothalamus and pituitary gland, the thyroid and parathyroid glands, the pancreas, the adrenal glands, and the gonads.

BB712 Genomics 3 credits

Genomics describes the determination of the nucleotide sequence as well as many further analyses used to discover functional and structural gene information on all the genes of an organism. Topics include the methods and results of analysis on a genome-wide scale as well as sequence alignment, biological database design, geometric analysis of protein structure. This course will student be able to read and understand primary literature in genomics, to use sequence databases and other bioinformatics databases, to incorporate genomic level data into research projects.

BB713 Synaptic structure and function 3 credits

Proper neuronal function requires integration of the transport of synaptic components and the assembly and regulation of synaptic structures and function. Neurons also require specialized mechanisms to transport mitochondria to axons and retain them in the vicinity of synaptic terminals where energy production and calcium homeostasis are in high demand. Synaptic structure and function undergo activity-dependent remodeling, thereby altering axonal transport. The goal of this course is to provide a basic synaptic function. This course will also advance our knowledge of fundamental processes that may affect human neurological disorders.

BB714 Cancer Biology 3 credits

This course introduces the fundamental principles of the molecular and cellular biology of cancer cells. Lectures and demonstrations explain causes of cancer, the role of growth factors, oncogenes, tumor suppressor genes, angiogenesis, and signal transduction mechanisms in tumor formation. Discussion of aspects of prevention, cancer epidemiology and principles of drug action in cancer management is part of the course. This course provides students with knowledge of cancer biology for their future research.

BB715 Protein Structures 3 credits

This course is an advanced course in structure. A detailed examination of DNA, protein, carbohydrate and lipid structures will be given. Structures will be examined in the context of structure/function relationships including the physical basis for structure and stability, molecular interactions, and design. Methods for structure determination will also be discussed. Structural features in protein-DNA interactions, protein-protein interactions, and other ligand-protein interactions are considered. Examples in structural proteomics and structural genomics are presented.

BB716 Stem cell biology 3 credits

This course is intended to teach current understanding of stem cells as it relates to their characterization, function, and physiologic and pathological states. Topics are covered by isolation, characterization, application of embryonic stem cells and adult stem cellsas well as recent advances in stem cell biotechnology.

BB717 Advanced Plant Developmental Physiology 3 credits

This subject provides the principles for the embryonic developmental processes of plants. It

covers the morphological, physiological, and developmental changes during embryogenesis. Pollen and embryonic sac formation, pollination and fertilization, and embryogenesis will be discussed.

◆ Biotechnical Course

BB646 Advanced Protein Engineering 3 credits

The structures and functions of proteins are determined by the amino acid sequences. Proteins function as catalyst or bioactive macromolecules. The function and catalytic activity of protein can be improved by the modern molecular biology and biotechnology. In this course, the structure and function of protein, protein engineering using molecular biological tools, overproduction and purification of recombinant proteins, and formulation will be lectured.

BB647 Fermentation Technology 3 credits

The basic principles for the cultivation of microorganisms in the general studies of microbiology are going to be essentially introduced. And the integration of biological sciences and organisms, cells, parts thereof, and molecular analogs for products and services are the major subjects. Since the quantitative kinetic analysis over the physiological phenomena is the key step to understand the biosynthesis of metabolites and compounds in microbial cells, the principles for the quantitative analysis will be practically experienced in the current topic.

BB648 Advanced Animal Physiology 3 credits

This advanced subject aims to deepen and intensify the knowledge on the introductory animal physiology expected to be mastered at undergraduate level. In order to achieve this aim, each student select his or her own specific topic to focus on, combine all the collectable contents from the literature books, and present the summarized results to discuss for the first half of the semester. For the second half, each student finds a more specified topic from some professional journals, review the selected papers, and present the extracted results to discuss. All the students must report their progressions in the weekly meetings with the written survey.

BB649 Advanced Entomology 3 credits

Insects are the most prosperous animal group with a very perpetual history and high diversity, and also very closely related with human life. These characteristics and significances of insects have been leading strong scientific interests, and the obtained results are considerably applied to bio-technological industry. Based on the structural, functional and behavioral understandings constructed preliminarily by the general entomology at undergraduate level, students will enhance their capabilities to figure out the entomological research trends and methodologies using current literatures and topics.

BB650 Characterization of Biopharmaceuticals 3 credits

This subject deals with case studies about efficacy and safety test of biopharmaceuticals. The principles and methodology of pre-clinical studies for the evaluation of biopharmaceuticals' safety and protein characterization will be lectured.

BB651 Advanced Biopharmaceutical Process 3 credits

The principles and methodology for the production of biopharmaceuticals (Protein therapeutics, therapeutic antibody, vaccine, and gene therapy etc.) and regenerative medicine (cell therapy, tissue engineered therapy, and artificial organ etc.) will be lectured.

BB652 Validation of Biopharmaceuticals Safety 3 credits

Biopharmaceuticals are originated from biological systems and the production processes are also based on biological properties. Generally purity and efficacy of the products are assured by using biological assays. Therefore special caution is required for the validation of safety. For approval of the biopharmaceuticals, safety of the product should be validated through Good Laboratory Practice regulations. This subject deals with theory and practical methods of general toxicology and biological assays for safety assurance of biopharmaceuticals.

BB653 Good Laboratory Practice : Theory and Practice 3 credits

In the experimental (non-clinical) research arena, the phrase good laboratory practice or GLP specifically refers to a quality system of management controls for research laboratories and organizations to try to ensure the uniformity, consistency, reliability, reproducibility, quality, and integrity of chemical (including pharmaceuticals) safety and efficacy tests. This subject deals with GLP regulation, theory and practice.

BB654 Soil Microbiology and Biochemistry 3 credits

The comprehensive reviews to aspect of biology and geochemistry related inorganic substances and soil biota in environment are introduced. Fundamental concepts and properties of diversity, morphological differences, geochemical processing in immobilization and mineralization, and bioconversion activities of soil biota is studied. Presentation based on the current research of bioremediation and biomass conversion.

BB655 Biology and Genetics of Filamentous Fungi 3 credits

This course will emphasize the understanding of fungal identification based on the growth and genomic homology, the metabolic diversity and enzyme production in environment, and cellular biology including commensalism and virulence in plants, animals, and humans. The role of fungi in environmental processes, the use of fungi as biological control agents to protect pests and pathogens, and the interactions between plants and mycorrhizal fungi will present. Presentation based on the current research of fungal biotechnology.

BB656 Microbiology of infectious diseases 3 credits

This course will emphasize the understanding of the interactions between human and/or animal and infectious pathogens. The mechanism of pathogenicity and the principles of the use of antibiotics and chemotherapeutic agents focused on the practical and molecular genetic level using model organisms will present. Contemporary topics including host-parasite interactions, defense mechanisms of host against pathogens, and genetic regulation of virulent genes in medical microbiology and pathogenesis are presented.

BB657 Food Biotechnology 3 credits

This course will emphasize the understanding of food processing, epidemiology, fermenting microorganisms, and food safety. The biological and chemical characteristics of food originated organisms, mechanisms of bioconversion, preservation and spoilage, and new technology in control of food-borne pathogens are presented.

BB658 Advanced Animal Developmental Physiology 3 credits

Animal development including embryogenesis is also a important living phenomenon proceeded according to the precisely programmed ways, exhibiting not only morphological aspects but also in very dramatic physiological situations. In order to figure out the animal development in terms of living activity, not only as morphological changes or differentiation, also the accompanied physiology must be monitored and understood. This subject informs the students with some important physiological events including the alterations in hormone titers and the accompanied fluctuations in major bio-molecules, etc. during the animal developmental process.

BB659 Molecular Diagnostics 3 credits

Molecular diagnostics is a new discipline that diagnoses human diseases and pathogens using molecular tools such as genomics, proteomics, or metabolomics. This subject deals with principles, methods and application of molecular diagnosis.

BB718 Advanced Molecular Virology 3 credits

This course offers advanced virology information to students who have already completed General Biology and Introductory Virology courses during their undergraduate years. The main topic of the course is human pathogenic viruses. During the first half of the class, viral life cycle will be analyzed at the steps of viral entry, pathogenesis and host immune responses. During this time, it will be taught how various molecular biological, cell biological, and biochemical methodologies are used to understand the interaction between the virus and the host cell, in the form of case studies using published papers. Throughout the second half of the course, particular virus families will be discussed, including herpesvirus, retrovirus, orthomyxovirus, poxvirus, flavivirus, as well as others.

BB719 Advanced Analytical Biotechnology 3 credits

Th ability to measure chemical and biological quantities is essential to science, engineering and medicine. The drive for improved manufacturing, product quality, health and safety, environmental monitoring and healthcare has fuelled the development of improved analysis. The course will provide specialist in-depth training and hands on experience of the growing range of new analytical techniques used in the Biotechnology sector.

BB720 Advanced Bionanotechnology 3 credits

Bionanotechnology refers to the intersection of biotechnology and nanotechnology. This subject deals with principles and application of biosensor/biochip, functional biological macromolecules, and molecular imaging.

BB720 Advanced Antibody Engineering 3 credits

An antibody, also known as an immunoglobulin, is a large Y-shaped protein used by the immune system to identify and neutralize foreign objects such as bacteria and viruses. The antibody recognizes a unique part of the foreign target, termed an antigen. Antibodies have been used as anti-cancer or anti-rheumatoid arthritis drugs. Also antibodies have been used as diagnostic tools. This subject deals with theory and practical methods for the biotechnological application of antibody.

BB720 Biomass and Bioconversion Technology 3 credits

This course will emphasize the understanding the noble characteristics and its treatments of organic waste originated bioorganisms. The principles of technology and biological processing to

produce clean bio-energy from natural and industrial organic wastes using specific microorganisms are studied. Presentation the Bio-engineering and technology based on the current research to cope with food and energy crisis.

BB721 Toxicology 3 credits

This course will emphasize the understanding the mechanisms of the toxic effects on biological system. Course content will cover the disadvantages of specific toxicant types (poisons, pesticides, solvents, oils, estrogen, estrogen mimics, carcinogens, natural toxins and pollutants) and the mechanisms for detoxification and tolerance on the cell.

BB722 Advanced Insect Molecular Biology 3 credits

Recently, many investigations on insect molecular biology are carried out since the obtained results are efficiently applied to bio-technological industry. This subject aims to analyze the topics on molecular biological works using insects as research material with the reports presented in recent international symposiums. The students must be preliminarily well knowledged with insect morphology & physiology, biochemistry and molecular biology, and expected to develop a capability to find new meaningful and worthwhile topics to investigate in insect molecular biology in taking this subject.

BB723 Insect Pheromones 3 credits

Pheromones are chemical messengers that triggers a natural response resulting in direct developmental effects on hormone levels or behavioral change in another member of the same species, and their use among insects has been particularly well developed and precisely documented. This subject deals with classification, characteristics and biosynthetic process of insects' pheromones, particularly with a focus on sex pheromones which are distributed ubiquitously in insect group.

BB724 Advanced Insect Behavior 3 credits

As the most prosperous animal group, insects inhabit in significantly wide range of conditions, and exhibit very variable ecological and behavioral features. Some of them, in particular, have developed very highly organized society which is comparable with that of social vertebrates. As well as their unique and characteristic life styles, the strong relationships of some species with human life make their behaviors and organizations very interesting as scientific subjects. The lectures provide students with some basic understandings on the variable and unique instinct, empirical and social behaviors exhibited in insect populations.

◆Reserch Course

Research for the Mater's Degree 1 0 credits

This course is for the 3rd term of the master's course students to learn an various matters from a thesis director to write out a master's thesis. This is the initial program of the guidance from an academic advisor.

Research for the Mater's Degree 2 0 credits

This is the last program of the guidance from an academic advisor about various matters such as analysis of research results, and examination of the master's thesis after taking 801 to write a master's thesis. This course is for the master's course student who is willing to examination of the

thesis in the last semester.

Research for the Doctoral Degree 1 0 credits

This is first educating course for the doctoral thesis. The purpose of this course is to educate 4th-semester students with an independent and self-critical approach to research.

Research for the Doctoral Degree 2 0 credits

Through training in the subject 811, graduate student should assess the data of ongoing research and ability to independently plan, lead, conduct and report research projects.

Research for the Doctoral Degree 3 0 credits

Through training in the subject 811 and 812, graduate student discuss his/her mentor on the experimental data and thesis writing. This course is for the student who complete the regular courses, or who is in preparation for the examination of thesis.