

## DEPARTMENT OF BIOTECHNOLOGY

### Academic Goals

Biotechnology is a multidisciplinary science for biochemistry, molecular biology, cell biology, and molecular medicine as well as an applied science focussing on the application of the biological principles and biomaterials to solve general problems of human beings including health, environment, energy and foods. The primary missions of the Department of Biotechnology are to investigate the fundamental principles of biology in living organisms including virus, microbes, plants, and animals, to create new biotechnologies necessary for future industries and to train students as basic scientists or investigators required for bio-industries such as biomedicine, biopharmaceuticals, environmental microbiology, and functional food.

### Fields of Study

- Biomedicine and Nanobio Systems
- Molecular Bioengineering
- Systems Food Biotechnology

### Major in Biomedicine and Nanobio Systems

Major in Biomedicine and Nanobio Systems is to seek and study solutions for human diseases through the biodetection & biondiagnostics and biomedicine, for sustainable and advancement in bioindustry and environment conservation through the bioenergy, biorefinery, and biosensor technologies by understanding life and living systems in terms of molecules, biomacromolecules, and cells by using nanobiotechnology and systems biotechnology tools. To accomplish this mission, various lectures related to the topics of omics, nanobiotechnology, biomedicine, biomass and bioenergy, signal transduction, systems biotechnology, molecular medicine, immunology, and so on are offered to the students as core or elective. In addition, major issues in biomedicinal industry, such as cGMP validation, safety, FDA approval and so on, are dealt as individual courses or workshops for yielding not only cGMP experts but also FDA experts.

## Major in Molecular Bioengineering

Main objective of courses majoring in Molecular Bioengineering is training graduate students as creative experts in the field of biomedical sciences. Students will acquire basic knowledges about molecular cellular biotechnology, animal physiology, material engineering and bioinformatics as well as obtain cutting edged technology involved in biomedical sciences. During the course of training, students will be involved in the specific given projects advised by faculty members. Major focus on research conducted by faculty members are including gene and cell therapies, manipulation of immune cells, development of novel therapeutic agents and materials suitable for biomedical sciences.

## Major in Systems Food Biotechnology

In the Major in Systems Food Biotechnology, excellent education and research opportunities are offered in the area of food science and biotechnology at MS and PhD levels. In particular, the fundamentals of the physical, chemical and biological properties of food materials are studied for the safety and functionality issues for foods, and the technological and engineering aspects of food processing and the application of biotechnology in the food and relevant industries are also important subjects. Due to the rapid advancement in systems biology, the genomic, proteomic, and metabolomic approaches to the study of the physiological responses and metabolism after food uptake and the bioprocessing of food materials are also emerging fields. Students in the program are encouraged to acquire basic knowledges and advanced research techniques in the above academic fields. Graduates are highly demanded from the industry, academic institutes, government agencies, and research institutes in the areas of food science and biotechnology.

## Degree Requirements

### 1. Master of Science (MS)

- 1) MS students must earn 24 course credits. Among the 24 required course credits, 1 from credit Seminars in Biotechnology 1,2,3 and 4 and 2 credits from Ethics in Research for Publication 1 and 2, but no more than 6 course credits are allowed from the seminar courses, such as seminars in Biotechnology, colloquiums in Systems Food Biotechnology, and so on.
- 2) Students must present at least one poster as a first author in domestic or international conferences or publish a paper as a first author or co-author in a scientific journal. The poster or paper must have the affiliation address as School of Life Sciences and Biotechnology, Korea University. Reprint(s) or acceptance letter(s) for the paper(s) has to be submitted to the office when M.S. candidates apply for a M.S. degree. The papers

should have a supervisor as a corresponding author in the case of full-time M.S. candidate, or have the first supervisor as a collaborating author in the case of part-time M.S. candidates who are registered in cooperative courses of University, Research Institute, and/or Industry.

## 2. Doctor of Philosophy (PhD)

- 1) PhD students must earn 36 course credits, Among the 36 required course credits, 2 from credit Seminars in Biotechnology 1,2,3 and 4 and 2 credits from Ethics in Research for Publication 1 and 2, but no more than 6 course credits are allowed from the seminar courses, such as seminars in Biotechnology, colloquiums in Systems Food Biotechnology, and so on.
- 2) For obtaining Ph.D., students must publish at least 2 papers as the major author (first or corresponding author) in SCI journals. However, it could be possible for the Ph.D. candidates to submit his/her Ph.D. dissertation if the candidate has one first-authored publication in any SCI journals, which is not only having its IF greater than 5.0, but also placed within the top 10% of any relevant journal category. (This will be applied for the students who are enrolled after March 1, 2015) If a paper published in a SCIE journal which has greater than 5 in its impact factor, it can be considered as one SCI journal paper. The paper must have the affiliation address as School of Life Sciences and Biotechnology, Korea University. Reprint(s) or acceptance letter(s) for the paper(s) has to be submitted to the office when Ph D. candidates apply for a doctoral academic degree. The papers should have a supervisor as a corresponding author in the case of full-time Ph.D. candidate, or have the first supervisor as a collaborating author in the case of part-time Ph.D. candidates who are registered in cooperative courses of University, Research Institute, and/or Industry.

## 3. Integrated MS-PhD

- 1) Integrated MS-PhD students must earn 54 course credits. Among the 54 required course credits, 2 from credit Seminars in Biotechnology 1,2,3 and 4 and 2 credits from Ethics in Research for Publication 1 and 2, but no more than 6 course credits are allowed from the seminar courses, such as seminars in Biotechnology, colloquiums in Systems Food Biotechnology, and so on.
- 2) For obtaining Ph.D., students must publish at least 2 papers as the major author (first or corresponding author) in SCI journals. However, it could be possible for the Ph.D. candidates to submit his/her Ph.D. dissertation if the candidate has one first-authored publication in any SCI journals, which is not only having its IF greater than 5.0, but also placed within the top 10% of any relevant journal category. (This will be applied for the students who are enrolled after March 1, 2015) If a paper published in a SCIE journal which has greater than 5 in its impact factor, it can be considered as one SCI journal paper. The paper must have the affiliation address as School of Life Sciences

and Biotechnology, Korea University. Reprint(s) or acceptance letter(s) for the paper(s) has to be submitted to the office when Ph D. candidates apply for a doctoral academic degree. The papers should have a supervisor as a corresponding author in the case of full-time Ph.D. candidate, or have the first supervisor as a collaborating author in the case of part-time Ph.D. candidates who are registered in cooperative courses of University, Research Institute, and/or Industry.

## **Comprehensive Examinations**

### **1. Doctor of Philosophy (PhD)/Integrated MS-PhD**

- 1) All students should take and pass a comprehensive oral examination or written comprehensive examination.
- 2) For the written comprehensive examination, students can choose any 4 courses among courses that the student took during his or her course work and have to pass all those 4 written examinations for each course.
- 3) In principle, two professors should make questions for each course. In the case one professor is only available for each course, the department academic committee has to approve it in prior to the examination.
- 4) To pass the written examination the score should be higher than 70 points out of 100 points for each course.
- 5) Pass of the written test is applicable to individual course and retest is performed only for the failed course.
- 6) Organization of examination committee members; the committee should be 3, including a chairman. A supervisor of students should be excluded from the committee and recommends three professors in the college of Life Sciences and Biotechnology, Korea University. The three examination committee members are not necessarily to be in the committee for the final defence Ph.D. of dissertation.
- 7) Students can pass the oral examination by the approval of at least two out of three committee members. The students have another chance to take the oral examination if he/she does not pass the first examination.
- 8) Students are not allowed to submit his or her doctoral graduation dissertation in the same semester when he/she pass the comprehensive examination, after students pass the oral examination.
- 9) A chairman of the committee must submit the oral examination report to the Dean of the College of Life Sciences and Biotechnology until the last day of the period of the oral examination.

### **2. Master Course**

- 1) All students should take the written comprehensive examinations.
- 2) For the written comprehensive examination, students can choose any 3 courses among courses that the student took during his or her course work and have to pass all those

3 written examinations for each course.

- 3) In principle, two professors should make questions for each course. In the case one professor is only available for each course, the department academic committee has to approve it in prior to the examination.
- 4) To pass the written examination the score should be higher than 70 points out of 100 points for each course.
- 5) Pass of the written test is applicable to individual course and retest is performed only for the failed course.

## **Lecture Language**

1. All the courses taught by full-time faculty in the Department of Biotechnology should be offered in English. However, the Biotechnology seminars 1, 2, 3, 4 and a few specific courses categorized for the professional job preparation, including Recent trends in Biotechnology, Recent trends in Bio-industry, and Biotechnology Internship 1, 2, may not be offered in English.
2. Any lectures offered by guest or invited lecturers must be offered in English in principle, but any special cases related to the lecturers or course subject can be approved in prior to the semester by the departmental academic committee.

## **Language in MS Thesis and Ph.D. Dissertation**

1. All the MS thesis or Ph.D. Dissertation under the supervision of the full time professors affiliated in the graduate Department of Biotechnology must be written in English.

## **ADDENDUM**

- 1) The regulations are applied to the new graduate students of the first semester 2014.
- 2) (Exception) Those, who were enrolled in the Department of Biotechnology before Sept. 1, 2013, may choose any of either rules, 1) the comprehensive exam regulation valid according to the year of his/her enrollment or 2) the current comprehensive regulation valid after March 1, 2014.

## ■ Courses and Syllabuses ■

### Core Courses

**BIO 901,902,903,904 Seminar in Biotechnology 1,2,3,4** [1],[1],[1],[1]

Invited speakers will present current research outcomes in the life sciences and biotechnology.

**BIO 923 Current Trend in Biotechnology** [2]

Invited industry speakers will lecture current biotechnology industry trends in research and development.

**BIO 925 Trends in Biotechnology Industry** [2]

Recent technology and trends of industrialization developed or applied in bioindustry will be taught in this course.

**BIO 907, 908 Ethics in Research for Publication 1,2** [2],[2]

This course provides the ethics in research for publication.

**BIO 917 Experimental Design and Statistical Analysis** [3]

Lectures on experimental design and statistical analysis of the results. Principles and statistical models of different experimental designs such as completely randomized, randomized block, nested, latin square, factorial, split plot are introduced. Programming and analysis employing SAS program for different experimental designs are also included.

**BIO 918, 919, 920, 921 Biotechnology Internship 1, 2, 3, 4** [3],[3],[3],[3]

Students will acquire hands-on knowledge needed for bioindustry by participating as an internship. This course will be co-opened with the bio-related companies.

### Major in Biomedicine and Nanobio Systems

#### Major Courses

**BTN 501, 502 Medical and Pharmaceutical Biotechnology 1, 2** [3],[3]

3Basic understanding on the pharmaceuticals medical sciences and knowledge on the development of biopharmaceuticals are lectured in this course.

**BTN 503, 504 Bioregulatory Sciences 1, 2** [3],[3]

This course covers the basic knowledge on cGMP in the manufacturing of biopharmaceuticals.

**BTN 508 Nanobiotechnology** [3]

This course covers the basic understanding on the nanoscience and the properties of nanomaterials, the interaction of nanomaterials and biomolecules, the biomolecules on nanostructured- or nano-materials, nanomaterials in biomolecules, and impacts of nanomaterials on biomolecules and lives, in addition to the future of nanobiotechnology.

**BTN 505, 506 Biochemistry 1, 2** [3],[3]

This course addresses the structures, function and their chemical properties of the basic monomeric biomolecules such as water, amino acids, nucleotides, fatty acids, and sugars and their corresponding polymeric macromolecules including proteins, nucleic acids, lipid, and carbohydrates.

**BTN 511, 512 Advanced Medical and Pharmaceutical Biotechnology 1, 2 [3], [3]**

The principles, development process, and production of biopharmaceuticals are lectured in this course.

**BTN 553 Fundamental Pathology [3]**

This course covers the pass of pathological microorganisms, mechanism of disease occurrence, cell and tissue damage, prevention, diagnostics and separation of infectious organisms, and basic knowledge on cancer biology.

**BTN 554 Pharmacotoxicology [3]**

This course covers the mechanism of action and toxicity of pharmaceuticals.

**BTN 555 New Drug Development [3]**

This course covers the principles and methods for the development of new pharmaceuticals.

**BTN 709, 710 Inflammatory lipid mediators 1, 2 (Teach in English) [3],[3]**

This course will review current research on inflammatory lipid mediators(eicosanoids) interns of their action in cancer and inflammatory diseases. In addition, we will review on cancer-inflammation linkage mechanism.

**BTN 601, 602 Special Topics in Medical and Pharmaceutical Biotechnology 1, 2 [3],[3]**

Students will present and discuss current special topics in medical and pharmaceutical biotechnology research in English.

**BTN 953, 954 Immunological Methodology 1, 2 [3],[3]**

The main goal of this course is for the students is to broaden their knowledge in the immunological methods and recent advances in the field of immune-related subjects.

**BTN 513, 514 Advanced Bioregulatory Sciences 1, 2 [3],[3]**

This course covers the basic knowledge on cGMP in the manufacturing of biopharmaceuticals.

**BTN 562 Validation of Cell Bank and Contamination Control [3]**

This course covers the validation and management of Master Cell Bank (MCB), Working Cell Bank (WCB), and End of Production Cell (EPC). The sterility test and environment monitoring of the source materials, intermediate products, and final products are also included in the lecture.

**BTN 563 Science Policy [3]**

This course covers national strategy for science and technology, planning and evaluation methods of research projects.

**BTN 581, 582 ICH Quality Guideline 1, 2 [3],[3]**

ICH Quality Guidelines for the Drug manufacturing GMP guidelines will be studied.

**BTN 973, 974 Current Good Manufacturing Practices 1, 2 [3], [3]**

cGMP regulations in various countries will be taught. Facility, Process Validation and Analytical Method development will be lectured.

**BTN 975, 976 Pre-Clinical and Clinical Trials 1, 2 [3],[3]**

Requirement of pre-clinical and clinical trials will be lectured. Good Laboratory Practices (GLP) and Good Clinical Practices (GCP) will be taught.

**BTN 977, 978 Quality Control and Quality Assurance 1, 2 [3],[3]**

Requirement and analytical test, control and documentation for QC/QA for pharmaceuticals will be lectured.

**BTN 609, 610 Special Topics in Bioregulatory Sciences 1, 2 [3],[3]**

Students will present and discuss current special topics in bioregulatory sciences research.

**BTN 957, 958 Nanotechnology in biology and medicine 1, 2 [3],[3]**

The subjects covered in this graduate course are nano-biosensors, nano-bio hybrid materials, nanomaterials including nanoparticles, carbon nanotubes, nanowires, etc, nano-biomachines, and the conceptual introduction to medicinal nanotechnology and the fundamentals in electronics and optics for nanotechnology.

**BTN 955, 956 Cell and Tissue Engineering 1,2 [3],[3]**

This course covers the recent knowledge on the cell and tissue engineering.

**BTN 507 Analytical Biotechnology [3]**

This course covers the broad range of analytical biotechnology methods which can be used for the research, development, and application in the fields of biomedicine, life sciences and biotechnology, by using electrical, electrical, biochemical, and electrochemical biosensors and nanobio-diagnostic technologies for early diagnosis and sensing of most important biomolecules, biomarkers, or diseases.



**BTN 712     Advanced Bionanotechnology** [3]

The course aims to study new strategy to bionanotechnology using biomimetics at the molecular level.

**BTN 715     Synthetic & Industrial Microbiology** [3]

Synthetic and industrial microbiology is the study of possible utilization of microorganisms in various industrial processes, or the processes in which the activities of these microorganisms may become significant in industries or in technology. Knowledge gained in this field has lead to the development of many concepts, which in turn resulted in action.

**BTN 714     Current Studies of Biofuels & Biorefinery** [3]

This class provides an in-depth presentation of a wide spectrum of technical issues related to biofuels and industrial chemical which are the substitutes for petrochemicals. The lecture begins with the most important issues on ethanol production from cellulosic biomass, which is more economically feasible and sustainable than ethanol production from corn. Courses are followed by discussions of the status of energy sources that are in various stages of development or imagination, including methane, methanol, hydrogen, electricity, butanol, and others.

**BTN 713     Mechanism & Regulation of New functional natural products** [3]

This class addresses functional product development from a number of perspectives: the process itself, health related research that may provide reaction mechanism, signal pathway, regulation.

**BTN 711     Biomass and Biochemistry** [3]

This course provides up-to-date information in the field of biomass conversion and its industrial application with biochemical tools.

**BTN 707     Current trends in Computational Genomics** [3]

Reviews on the current trends in computational genomics in terms of their various algorithm and application.

**BTN 813     Theory in Protein design** [3]

The course covers various protein design principles (e.g. molecular evolution) and studies the algorithm and experimental technique.

**BTN 814     Current trends in Systems Biotechnology** [3]

Surveys on the major differences between traditional biotechnology and systems biotechnology. The course introduces recent experimental techniques and research trends.

**BTN 541, 542     Special topics in Biochemistry 1, 2** [3], [3]

This course provides the general principles of biochemistry in English.

**BTN 708     Advanced Synthetic Biology** [3]

The course introduce the definition and coverage of synthetic biology and current research trends in its application.

**BTN 983, 984     Research in Medical and Pharmaceutical Biotechnology 1, 2** [2], [2]

Course focuses on reading the latest medical and pharmaceutical biotechnology research papers and presenting the assignment on research methods.

**BTN 607, 608 Research in Bioregulatory Sciences 1, 2 [2], [2]**

Course focuses on reading the latest bioregulatory sciences research papers and presenting the assignment on research methods.

**BTN 985, 986 Research in Bionanotechnology 1, 2 [2], [2]**

Course focuses on reading the latest Nanobiotechnology research papers and presenting the assignment on research methods.

**BTN 981, 982 Research in Biochemistry 1, 2 [2], [2]**

This course practices the reading, understanding, and presentation for the selected papers published in the field of biochemistry, in addition to access to the various instruments.

**BTN 717, 718 Biosystem of Inflammatory Human Diseases 1, 2 [3], [3]**

In the course of Biosystem of Inflammatory Human Diseases-1,2, the general principle of inflammatory pathogenesis leading to various human diseases such as asthma and cancer will be reviewed.

**Major in Molecular Bioengineering****Major Courses****LAB 501 Advanced Cell Biology I [3]**

This course is open to students in the master's program and involves lectures and individual presentation on biochemical, structural, physiological and genetical characteristics of eukaryotic cells.

**LAB 503 Advanced Cell Engineering I [3]**

This course with cell and molecular biology background provides the fields of advanced knowledge about regulation and manipulation of cell for the purpose of clinical application. This course involves lectures and discussion with current topics on the cell engineering.

**LAB 505 Advanced Stem Cell Biology I [3]**

Purpose of this course is to introduce the advanced knowledge about molecular mechanisms underlying the pluripotency/differentiation of stem cell and the extra-and intra-cellular signaling mechanisms, by which the fate of stem cells is regulated during early differentiation.

**LAB 512 Advanced Animal Genetics [3]**

This course provides the fields of Mendelian law, inheritance, crossing and chromosome map. Also, this course provides the conventional areas of blood groups, protein polymorphism and disease resistance in economically important and domestic species of animals.

**LAB 515 Molecular Signal Transduction [3]**

This course provides a basic concept of biochemical and molecular cellular biological changes on a variety of extra- and intra-cellular signaling.

**LAB 516 Basic Concept of Autoimmune Disease [3]**

This course provides you information about the symptoms of autoimmune diseases and the recent trend of immunotherapy used in autoimmune diseases. You have to develop the ability to find new bioengineering-related medical treatments for autoimmune diseases at the end of course.

- LAB 517     Advanced Reproductive Medicine** [3]  
Reproductive physiology and assisted reproductive technology with respect to endocrinology, cell biology, molecular biology, and immunology will be introduced.
- LAB 532     Nutritional Ecology** [3]  
The evolution of anatomical structure and functional characteristics of digestive tract from the standpoint of ecology and comparative nutrition, discussing plant-animal interaction, capacity of microbial fermentation within the gut and energy yielding system.
- LAB 613     Gastro-intestinal Microbial Ecology** [3]  
Discussion on the symbiosis of host animal and gut microbes, classification of microbes, physiological condition of habitat, evolution of mutualistic fermentative digestion, characteristics of fermentative enzymes, features of polysaccharide degradation, and methodology in gut microbiology study.
- LAB 626     Advanced Growth Factors** [3]  
This course will discuss general characteristics of polypeptide growth factors.
- LAB 633     Protein and Amino Acid Metabolism** [3]  
Digestion and absorption of protein, protein quality, protein synthesis and degradation, amino acid metabolism.
- LAB 634     Carbohydrate and Lipid Metabolism** [3]  
Digestion and absorption, metabolism and its control, energy metabolism, relations to other nutrients of carbohydrate and lipid.
- LAB 643     Advanced Tissue Engineering I** [3]  
This course provides the current topics of tissue development for the regenerative medicine. Topics will include disease model, specific tissue development and current status of tissue engineering. Course involves lecture and discussion.
- LAB 651     Advanced Developmental Biology** [3]  
This course will discuss about current topics in developmental biology, including 1) gametogenesis 2) fertilization, 2) morphogenesis, 3) pattern formation, and emphasize on the understanding of development, growth and differentiation involved in early development of human embryos.
- LAB 662     Advanced Endocrine Factors** [3]  
Lectures are open to students in the master's program and involves lectures and discussions on the endocrine system and properties of endocrine hormones in general.
- LAB 705     Advanced Regulation of Cell Differentiation I** [3]  
This course provides the advanced knowledge about a wide range of factors regulating differentiation of cells, and the signaling mechanism by which the factors control the fate of different cell types.
- LAB 717     Quantitative Genetics** [3]  
The course provides quantitative genetics and relevant breeding theories. Main topics in quantitative genetics are qualitative and quantitative traits, genetic variance, mating design, heritability, genotype and environment interaction, genetic correlation, selection differential and genetic gain. Different breeding theories such as selection breeding, hybridization breeding, mutation breeding and marker-aided breeding will be introduced.

**LAB 721      Advanced Cancer Biology [3]**

This course provides a basic concept of tumorigenesis and progression as well as a recent progression of diagnostic and therapeutic approaches.

**LAB 730      Molecular Genetics of Cancer [3]**

This course provides a basic concept of tumorigenesis and progression by focusing on genetic alterations of oncogenes and tumor suppressor genes.

**LAB 733      Bioinformatics [3]**

The objective of this course is to provide computational background and useful bioinformatics resources for application on current research fields. Topics will be chosen based on students' interests.

**LAB 741      Advanced Microbial Pathology in Animals and Humans [3]**

This course enables you to understand the types, characteristics and routes of infection of pathogenic microorganisms and virus in animals and humans. It also helps you to understand the recent trend of microbial pathologic research.

**LAB 744      Animal Model for Biomedical Study [3]**

This course provides you information about the fine mechanism of individual animal models for specific human disease. It also helps you to understand the theory and mechanisms of transgenic animals and knock out animals.

**LAB 755      Invertebrate Models for Biomedical Research [3]**

This course explores the use of genetics in a non-vertebrate model system, *Drosophila melanogaster*, to elucidate fundamental mechanisms underlying developmental processes.

**LAB 757      Principal of metabolomics in humans and animals [3]**

Metabolomics is the scientific study of chemical processes involving metabolites. Specifically, metabolomics is the "systematic study of the unique chemical fingerprints that specific cellular processes leave behind", the study of their small-molecule metabolite profiles. The purpose of this lecture is to give a strategic long-term plan to revitalize the national small molecule approach and to obtain the elementary data necessary to determine a policy for effectively supporting metabolites from humans and animals

**LAB 758      The Biologic Basis of Obesity [3]**

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems. Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis. Obesity is a leading preventable cause of death worldwide, with increasing prevalence in adults and children, and authorities view it as one of the most serious public health problems of the 21st century.

The purpose of this lecture is to introduce "Principal and/or Biologic Basis of Obesity". Also, this lecture will give a talk about "Relationship between obesity and metabolic syndrome" as well as "How obesity affects social life". Finally, this lecture will give a strategic long-term plan to study the anti-obesity approach and to obtain the elementary data necessary to determine a policy for effectively supporting obesity research.

**LAB 759      Biomaterials and Bioengineering** **[3]**

Based on understanding the biophysical properties of various biological polymers, this lecture will focus on the current issues of tissue engineering, devising processes to control the differentiation and/or the engraftment of stem cells and understanding the underlying mechanisms of these processes. Additionally, new materials for tissue engineering and stem cell delivery as well as for other applications such as drug delivery will be discussed, and then the molecular mechanisms of the host response to biomaterials and biomaterial-based devices will be discussed.

**LAB 760      Current Regenerative Medicine** **[3]**

Stem cell research has paved the way for the transformative potential of regenerative medicine. By harnessing the power of stem cells to repair or replace tissues that are damaged by injury or disease, the promise of regenerative therapies is making its way into the clinic. Based on the recent scientific discoveries about the fundamental mechanisms that govern stem cell function, this lecture discuss the current progress in developing new therapies for human patients with various intractable diseases such as heart disease, lung disease, muscle disease, vision loss, diabetes, and neurological disorders.

**LAB 761      Advanced Molecular Breeding I** **[3]**

This course provides informations on the principles of selection and traditional breeding program, marker-assisted selection (MAS), computational simulation as well as applications for the use of DNA marker in breeding program.

**LAB 811      Metabolic Disorders and Toxicology** **[3]**

Discussion on various toxicities, digestive and metabolic disorders, etiology, progress, prognosis and prevention.

**LAB 812      Vitamin & Mineral Nutrition** **[3]**

Chemical structures, characteristics and physiological functions of water-soluble and fat-soluble vitamins, deficiencies, requirements. Existence of minerals within animal body, physiological functions, requirements and interactions of macro- and micro-minerals.

**LAB 814      Advanced Regulation of Cell Differentiation II** **[3]**

This course provides the advanced techniques for guided differentiation of various cell types in the class.

**LAB 822      Advanced Cell Biology II** **[3]**

This course is open to students in Ph.D. program and involves in depth discussion on both related papers recently published and recent development in cell-based biotechnology industry.

**LAB 842      Advanced Cell Engineering II [3]**

This course with cell and molecular biology background provides the fields of advanced knowledge about regulation and manipulation of cell for the purpose of clinical application. This course involves lectures and discussion with current topics on the cell engineering.

**LAB 843      Advanced Tissue Engineering II [3]**

This course provides the current topics of tissue development for the regenerative medicine. Topics will include disease model, specific tissue development and current status of tissue engineering. Course involves lecture and discussion.

**LAB 852      Advanced Stem Cell Biology II [3]**

As a continued course of Advanced Stem Cell Biology I, the advanced information on the differentiation processes towards specific cell types and the method for guided differentiation into several desired cell types will be given to graduate students.

**LAB 863      Advanced Nutritional Biochemistry [3]**

Comparative regulation of macronutrient metabolism. Carbohydrate metabolism, mitochondrial interactions, protein metabolism, lipid and lipoprotein metabolism, and Integration of regulation and nutrition.

**LAB 864      Methodologies in Nutritional Biochemistry [3]**

Sample preparation and analysis, experimental surgery, use of radioactive isotopes, statistical analysis.

**LAB 871      Advanced Regulation of Gene Expression [3]**

This lecture will focus on basic molecular and cellular biological concepts underlying various regulation for gene expression.

**LAB 920      Advanced Genetic Variations and Diseases [3]**

The course can provides comprehension about associations with disease. These studies search for genetic variants of specific candidate gene or genome on well-knowing genome sequence and structure. After that, they are used for the genetic marker.

**LAB 935      Genomics [3]**

This class focuses on current updates in genomics research area. The class includes current researches including genome sequence, structure, modification and genome comparison.

**LAB 940      Advanced Molecular Breeding II [3]**

This course provides enhanced knowledge of breeding material and systems ;better understanding of Quantitative Trait Loci (QTL) for the most effective breeding program. These include experimental design, QTL mapping, QTL detection, and comprehensive QTL analysis.

**LAB 941      Special Topics in Epigenomics [3]**

This class focuses on recent advancements in epigenomic research. The course will cover major advancements in this field based on reviews. The course will cover epigenetic mechanism of gene regulation, genomic imprinting, DNA and chromatin modification.

**LAB 943      Immunotherapy for Hypersensitivity [3]**

During the course, you can understand key molecular mechanisms in immune cells during hypersensitivity. This course also gives you ideas about both principles and techniques important for treatment of hypersensitivity.

**LAB 944     Principle of Antibody Engineering [3]**

During the course, you can learn about the antibody producing process, detailed structure of antibodies and the knowledge about antibody reactivity against variable antigens. This course also provides you information about the efficient antibody producing method and immunotherapy using such antibodies.

**LAB 945     Special Topics in Systems Biology [3]**

Recently, several high-throughput techniques were employed in modern biology. These techniques generate whole genome sequence, transcriptome, proteome, and metabolome data. This course focuses on recent advancement in this area to help establishing new research direction.

**LAB 955     Methods in Cancer Biology [3]**

This course introduces the advanced methodologies involved in researches on tumorigenesis and progression.

**LAB 971     Advanced Molecular Biology [3]**

This course will discuss and present seminars covering current research trends in genetic structure and gene expression regulation.

**LAB 981     Advanced RNA Biology [3]**

This course will present and discuss diverse roles of RNA molecules in biological processes and hot topics in RNA Biology.

**LAB 983     Current Methods in Molecular Biology [3]**

This course will present current methods in molecular biology, experimental strategy and data analysis, and also discuss molecular biological approaches to understand biological events at molecular level.

## **Major in Systems Food Biotechnology**

### **Major Courses**

**LEC 507     Advanced Food Biochemistry [3]**

In-depth discussion of the biochemical modes of action of active principles in food, and the effect of oxidative stress on health are analyzed with biochemical approach.

**LEC 527     Food Microbiology [3]**

This course is designed to provide general knowledge for a study of food microbiology. This course will cover understanding of food or food contact environments, determination of microorganisms in various types of foods, introduction of important spoilage and/or pathogenic bacteria, introduction of various methods developed to decrease microbial problems, and HACCP.

**LEC 535     Advanced Topics in Food Biomedical Science [3]**

This class will cover basic mechanism how functional foods and nutraceuticals should be tested for efficacy and safety for product development. Application of basic molecular and cellular mechanism will be intensively studied

**LEC 530     Food Engineering I [3]**

Study basic theories and practices for fluid mechanics, heat transfer and mass transfer in advanced food and biomaterial processes.

**LEC 515      Advanced Muscle Foods** **[3]**

In-depth discussion of muscle structure, composition, contraction, postmortem events, muscle growth, adipose tissue, connective tissue, tenderness, lipid deterioration, meat color and its measurement, meat microbiology, and meat in human nutrition.

**LEC 519      Food Preservation** **[3]**

The biological, chemical and physical factors governing the spoilage, preservation and shelf-life of food will be reviewed, and the postharvest technology, chilling, CA and MA storage, fermentation, freezing, drying, concentration, thermal and high-pressure sterilization and irradiation methods and their effects on food quality will be discussed.

**LEC 521      Food Carbohydrate Chemistry** **[3]**

Teach and discuss on the recent research on basic science and technology for food carbohydrates, including the chemical structure, physical properties, biofunctions, as well as utilization in non-food area such as medicines and cosmetics.

**LEC 531      Advanced Food Microbiology** **[3]**

Lectures on the classification, identification, growth, and metabolism of microorganisms related foods. Special emphasis on the genetics and biotechnology in food industry.

**LEC 528      Advanced Food Safety** **[3]**

There are growing interests in food safety. This lecture discusses in depth the food safety issues, the risk assessment, and the risk management covering various safety topics associated with food production.

**LEC 529      Advanced Food Hygiene** **[3]**

International trends and perspectives and areas for future work in food safety will be discussed. This course also deals with advanced knowledges related with food safety including biological, chemical and physical hazards associated with food poisoning, safety evaluation methods, and control and detection methods.

**LEC 650      Food Engineering II** **[3]**

Study basic theories and practices for drying and thermal processing, distillation, and concentration in advanced food and biomaterial processes.

**LEC 533      Lipid metabolism and life-style diseases** **[3]**

Study the effects and role of cholesterol on various chronic diseases such as hyperlipidemia, coronary heart disease, diabetes, and osteoporosis. Biological regulation and action mechanism of critical biomarkers in cholesterol metabolism and read major papers regarding the topics.

**LEC 627      Meat Product Evaluation** **[3]**

The study and practice of commercial meat processing methods including curing, smoking, sausage manufacturing and the manufacture of ready-to-serve meat products. Designed to teach basic meat processing operations(curing, smoking, sausage manufacturing, etc.), factors influencing raw materials functionality, product evaluation, packaging, safety and preservation.

**LEC 628      Advanced Dairy Technology** **[3]**

Lectures on milk dairy foods on the aspects of chemistry, physiology and microbial properties.



**LEC 630      Advanced Food Toxicology** **[3]**

Principles in toxicology. Toxins in Food: mode of action, defensive systems against toxic substances, interaction of toxins and nutrients, risk assessment.

**LEC 632      Special Topic in Hazard Analysis Critical Control Point** **[3]**

This covers the following topics; Offer to knowledge related with analysis of food hygiene and safety system of CODEX regulation, EU, USA and Japan, analysis of the Seven Principles for HACCP introduction, analysis of biological, chemical, physical hazard , study of preharvest and postharvest steps for HACCP application, perform HACCP plan of various foods and understanding of the HACCP principles and apply to food safety.

**LEC 638      Advances in Biofunctional Foods** **[3]**

Teach and discuss on the various health-promoting functions of food components such as control and activation of physiological process, prevention of aging and cancer, taste modification, immunomodulation, etc.

**LEC 640      Special topics muscle foods** **[3]**

Seminar and discussion about muscle biology and meat science using the most recent topics

**LEC 642      Advanced Topics in Nutrition and Public Health** **[3]**

To study preventive effects of foods and nutrients on human diseases, we will learn human experimental techniques including epidemiology and clinical trials. Basic facts regarding foods and nutrient effects on disease prevention and learn up-to-date research papers in the field.

**LEC 647      Advanced Meat Processing and Technology** **[3]**

Included in this course are the scientific background to meat processing. This course concentrates on curing, smoking and fermentation techniques of meats. This course combines lecture and laboratory work including the quality assesment of sausage, ham, bacon, etc.

**LEC 648      Advances in Food Chemistry** **[3]**

Teach on the chemical properties of major food components such as moisture, carbohydrates, proteins, and lipids as well as minor components such as vitamins, minerals, flavor and color compounds, and biofunctional compounds using recent literatures.

**LEC 649      Food Packaging Engineering** **[3]**

Study characteristics and mechanical and chemical properties of food packaging materials for macro and micro packaging as well as recent information in food packaging technologies.

**LEC 657      Antimicrobial Resistance Mechanism** **[3]**

Lecture and discussion on antimicrobial resistance of foodborne pathogens and risk assessment of the antimicrobial resistant microorganisms from clinical and non-human area

**LEC 658      Biomass and Biorefinery** **[3]**

This course deals with the up-to-date technology and industrial trends in the area of biobased products and bioenergy which is emerging due to the global warming and pollution. The principles and applications in the relevant areas are lectured in the wide aspects of biomass feedstocks, bioprocess, microbial and enzyme catalysts, and biorefinery.

**LEC 659      Genomics and bioinformatics in food science      [3]**

Genomics is a 21-century science that has been emerged since the human genome project. After the invention of DNA microarray, genomic transcriptome profiling has been possible and application of genomic research tool to food science and nutrition is called nutrigenomics, which is regarded as a powerful technique to investigate global gene expression profile changes due to food and nutrient intake. This class will cover DNA microarray technology, data interpretation, and also learn bioinformatics to store, search, examine, and interpret massive biological data base. Critical reading of recent papers in the field is also important and major part of the class.

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**LEC 709      Water in Foods      [3]**

This course covers; the classification of waters in food, the functionality of water, the sorption isotherms, BET-layer, and the theory of water activity and its practical significance in food industry. Also includes is the effect of water activity upon the quality of preserved foods.

**LEC 710      Frozen Foods      [3]**

This course covers; definition of frozen foods, reverse Carnot cycle, calculation of freezing efficiency, freezing curve, quick freezing, slow freezing, refrigeration load and storage stability of frozen foods.

**LEC 713      Probiotics in Food Science      [3]**

Lectures on probiotic bacteria. Special emphasis on the selection, characterization and the technical aspects of health benefits of probiotics.

**LEC 717      Metabolic Engineering of Food Microorganisms      [3]**

To economically produce valuable food and biomaterials on a large scale, the principles and technologies of metabolic engineering which aims at the planned and strategic manipulation of microbial metabolism is lectured. Also, the actual cases of enhancement in product yield, productivity, and the development of novel product, expansion of substrate usability and novel biosynthetic pathways are discussed.

**LEC 728      Starch Chemistry      [3]**

Teach and discuss on the various physical and chemical properties of starch such as granule and molecular structure, chemical and physical properties, isolation process, modification, industrial utilization, etc.

**LEC 730      Membrane Separation Technology      [3]**

Lecture and discussion on the membrane separation technology including ultrafiltration, reverse osmosis and microfiltration, and its applications in food processing

**LEC 734      Functional Metabolomics** [3]

To study the metabolism of foods, and to optimize and monitor the metabolite production by microorganisms, the qualitative and quantitative measurement of cellular metabolites on a global scale is becoming essential thus providing a broad view of the biochemical status of an organism. In this course, the principles of metabolomics, the instrumental tools of metabolomics such as GC-MS, LC-MS, and NMR, the multivariate analysis including principal component analysis and PLS-DA are lectured and discussed.

**LEC 813      Special Topic in Microbial Stress Adaptation** [3]

This course deals with essential and advanced knowledge about microbial adaptation to stress and relevance of this phenomenon to food safety. Responses of pathogens to physical and chemical stresses encountered food processing, adaptation of food microbiota to stress as a survival strategy, physical and molecular mechanisms of microorganisms, and strategies to overcome stress adaptation in foodborne pathogens will be discussed.

**LEC 643      Physical Property and Quality Control of Food** [3]

Among the food quality attributes the physico-chemical and rheological analysis of the sensory characteristics, such as color, flavor and texture, will be made and the instrumental and organoleptic test methods will be reviewed. Sensory evaluation methods and the statistical treatment of the data, and construction of control chart will be exercised.

**LEC 639      Foodborne Pathogens** [3]

This course is designed to provide detailed information on microbiological hazards in foods such as foodborne pathogenic viruses, bacteria, parasites, prions, etc. In this lecture, various types of pathogens and their characteristics, symptoms of diseases, detection methods, treatment of patients, and prevention measures will be intensively covered.

**LEC 729      Microbiological Risk Assessment** [3]

Concepts, principles and techniques of microbiological risk analysis will be discussed to provide powerful analytical tools for dealing with microbiological and epidemiological information, reaching and communicating decisions and then taking preventative actions that are appropriate to the hazards.

**LEC 517      Advanced Food Biotechnology** [3]

For the food and bio-industries involving various biological systems, the advanced principles and technologies in bioprocess engineering such as enzyme kinetics, microbial growth kinetics, animal and plant cell culture, bioreactor design and operation, bioprocess optimization, heat and mass transfer, and product recovery are dealt in this course.

**LEC 654      Colloquium on Food Bioscience and Technology I** [3]

MS students have opportunities to present about the current research topics in food science and technology.

**LEC 655      Colloquium on Food Bioscience and Technology II** [3]

PhD students have opportunities to present the results from their thesis and dissertation researches.

**LEC 807      Current Topics on Food Biochemistry** **[3]**

Physical and chemical changes during food processing and storage, and their biochemical implications in current research trends

**LEC 840      Food Safety Policy** **[3]**

Lecture and discussion on the desirable food safety policy based on sound risk assessment, risk management, and risk communication