

National Chiayi University

Institute of Bioagriculture Science

(For freshmen of the academic year 2010)

(2010.01.11) Department Commission on Curriculum passed

(2010.01.27) College Commission on Curriculum passed

(2010.03.09) University Commission on Curriculum passed

(2010.04.20) Academic Affairs Committee passed

I. Development and features

The research and development of our institute focused on the application of biotechnology and gene technology in agriculture R & D operations. Combined with industry to develop new products or technologies to improve the technology and industrial competitiveness of our agricultural science. Teaching to train future professionals in agricultural biotechnology targeted to meet the demand of Yunlin, Chiayi, and Tainan development in the biotechnology industry, and further developed into an international agricultural biotechnology R & D center.

II. Goals

1. With the molecular biology, biochemistry, and physiology knowledge.
2. With the knowledge of theories and practice on biotechnology.
3. With the knowledge of genomics, proteomics, and bioinformatics.
4. With transgenic animals and plants knowledge.

III. Basic competence indicators

1. Cross-knowledge of biology, economic zoology, and crop science.
2. Knowledge of molecular biology, biochemistry, and physiology.
3. The fabrication of laboratory animal and management ability.
4. The interdisciplinary ability of integrating crops, economic zoology, laboratory animal, and biotechnology.
5. Tissue culture of animals and plants and gene operation.
6. The application of biotechnology to creative studies on agriculture.
7. Cultivate the cross-ability on agricultural field research and commercialize.
8. Cultivate international perspective and vision.

Academic requirements

Credits for graduation:

The completion of a minimum 30 credits course work is required, including

Obligatory professional courses 6 credits, Elective professional courses 18 credits, and Master thesis 6 credits.

Others:

At least 12 credits of elective professional courses of the institute.

First Academic Year

Compulsory Required

Courses	Session	Teaching Hours	Credit Points	Ref.
Advanced Biochemistry	1	2.0	2	
	This course will teach the topics including: I) A high degree of chemical complexity and microscopic organization. II) Systems for extracting, transforming, and using energy from the environment. III) A capacity for precise self-replication and self-assembly. IV) Mechanisms for sensing and responding to alterations in their surroundings. V) Defined functions for each of their components and regulated interactions among them. VI) A history of evolutionary change.			
Seminar (I)	1	3.0	1	
	The program of Seminar (I) is designed for new graduate students how to present a scientific work in public. It includes some basic steps for the training: how to prepare the present powerpoint file, the performance of presentation, how to organize and explain cited scientific papers, how to response the questions from the audience, and how to accomplish the paper work of the presentation for master evaluation.			
Seminar (II)	2	3.0	1	
Total			4	

Selective Required

Courses	Session	Teaching Hours	Credit Points	Ref.
Development and applications of molecular vaccines	1	1.0	1	
	Vaccines can be used to induce the immune response of living organisms. The approaches to develop and generate various vaccines will be addressed. The regulation and good manufacture protocol of producing vaccines are also introduced.			
Laboratory of Development and Applications of Molecular Vaccines		3.0	1	

	Students will have the hand on opportunities to design, express, and purify antigens. The methods of identifying pathogens are included. The development of attenuated viral vaccines is performed. Finally, students will visit the GMP vaccine factory in Taiwan to realize the procedure of generating vaccines.			
Special Topics on Molecular Pathology	1	2.0	2	
	This introduction to human disease includes etiology and mechanisms of common disease states and integrates pathology with previous core curriculum. The focus will be to understand disease processes and the dynamics of changes related to drug therapy. Our goal is to give the student an overview of the illnesses and disorders of human organs, systems and functions, in other words, human disease, with the hope that this background will lead the students to clinical understanding of patients and future insight into the pathogenesis of disease and new treatments.			
Laboratory of advance biotechnology		3.0	1	
Lab. of Bioinformatics	1	3.0	1	
	The course teaching student 1. DNA sequencing and blast, alignment. 2. Application of LC/MS/MS in protein sequencing and mass spectrometry, search in mascot database ° 3. Microarray data processing, and using software in gene annotation, clustering and metabolomics ° 4. Prediction of protein structure and function in dry lab.			
Biological Image Technology		1.0	1	
Lab. of Biological Image Technology	1	3.0	1	

Accumulation of Biomass and Conversion of Bioenergy		1.0	1	
	Facing the rapid depletion of fossil oil within the next 50 years, alternative energies must be adopted. Among the alternative energies, bioenergy is considered feasible and sustainable, and environment-friendly, as it is carbon neutral and renewable with fewer pollutants produced. The subjects covered in this course include: (1) Energy crops and improvement via genetic engineering – corn, sugarcane, cassava, grasses, woods, oil palm, sunflower, canola, (2) Synthesis of biomass: synthesis of sucrose, starch, cellulose, hemicellulose, lignin, and lipids, (3) Fermentation from sugars and production of ethanol, (4) Anaerobic organisms and production of methane, (5) Hydrogen production from microalgae, (6) Microorganisms and degradation of cellulose and hemicellulose to glucose and xylose, (7) Conversion of plant oil to biodiesel – lipase, acid/alkaline hydrolysis, (8) Improvement of microorganisms – tolerance to ethanol and other stress conditions, (9) Improvement of hydrolytic enzymes via protein engineering.			
Treatment of Livestock Waste	1	2.0	2	
	Livestock emissions produced by the human equivalent of 10 times the emissions, improper handling discarded very huge damage to the environment. How to solve the livestock production process of waste generated, for the livestock to be an important issue. The aim of this course design effective solutions to the problem of poultry and livestock waste emissions, while the use of more active treatment, the poultry and livestock waste end products to foster the universalization of the emerging organic agriculture.			
Advanced Molecular Biology		2.0	2	
	Molecular biology and its associated fields, such as genetics and computational biology, may fall under the study areas of chemistry, biology or bioinformatics. Online molecular biology courses are available as introductory courses for the undergraduate student or as advanced courses for the graduate student.			
Advanced Molecular Genetics	1	2.0	2	

	<p>By utilizing the technologies derived from molecular biology, the conventional genetics research can be greatly facilitated.</p> <p>This course will combine the applications of molecular markers and phenotype observation to deduce the inheritance pattern of living organisms.</p>			
Lab. of animal reproduction technique		3.0	1	
Animal Development	1	2.0	2	
	<p>This course will first introduce students to the three principles, experimental embryology, developmental genetics, and molecular biology, which are currently composed of the modern developmental biology, and further techniques used for studying developmental biology will be introduced as well.</p> <p>The second part of this course will take six animal models for example to compare the developmental mechanisms among species.</p>			
International Frontier Biotech Course		1.0	1	
	<p>The course is derived from the biotechnology programs funded by the Department of Education. It consists of different topics presented by invited speakers from industry. Those speakers would like to provide useful opinions for students who will be involved in professional jobs in biotech companies, present and future biotechnological developments for their companies, the creation of new techniques for company expansion, and the company regulations and operations.</p>			
Genomics	1	1.0	1	
	<p>The course will provide a broad introduction to genomics. Designed to provide the student with the basic principles of genomics, including scientific method, various sources of information, gene expression and regulation and genetics.</p>			
First Academic Year				
Selective Required				
Courses	Session	Teaching Hours	Credit Points	Ref.
Lab. of Genomics	1	3.0	1	

	The laboratory portion of the course consists of topics correlating with lecture. The laboratory topics are designed to learn how to handle the various sources of information, new technologies, and gene manipulation.			
Visiting of Agricultural Industry	1	3.0	1	
	This program is for students to directly contact agricultural industries and research units to understand practical operations and production problems. To meet our departmental development trend, the course focuses on the area of agricultural crop production. The course is set to visit orchid plantations, government research units such as flower research center. During the visiting, let students face and ask agricultural experts to achieve understanding the properties and problems of practical crop production. The course can increase students' intends to involve in the agricultural production.			
Proteomics		1.0	1	
	<p>Genes are the support for transmission of genetic information, most of the chemical reactions inside cells are carried out by proteins, which are the functional products of gene expression. Taking under consideration alternative splicing of mRNA and post-translational modifications, adding further proteins interact one with another and the proteome is intrinsically dynamic as it varies between cell types and from physiological condition to condition as occurs in living cells. There is no doubt that proteome is going to be a much more difficult and complex task. The course will cover the integration of geneomics and proteomics, and measurement of protein expression and mass spectrometry, the applications of proteome in biological research and Biomedics and Pharmaceutics.</p> <p>The contents:</p> <p>Chapter 1. Proteomics today, proteomics tomorrow</p> <p>Chapter 2. Proteomic technologies</p> <p>Chapter 3. Application to the study of heart disease</p> <p>Chapter 4. Applications in drug discovery and toxicology</p> <p>Chapter 5. Phage antibodies as tools for proteomics</p> <p>Chapter 6. Glycobiology and proteomics</p> <p>Chapter 7. Proteomics as tool for plant genetics and breeding</p> <p>Chapter 8. Proteomics to explore Pathogenesis and drug Resistance</p> <p>Chapter 9. Bioinformational applications in Proteomic</p>			
Lab. of Proteomics	1	3.0	1	

	<p>The lab course include</p> <p>Exp. 1. Two-dimension gel electrophoresis:</p> <p>Exp. 2. LC/MS/MS</p> <p>Exp. 3. Gel staining: Coomassie blue and silver</p> <p>Exp. 4. Protein extraction and digestion</p> <p>1. Spot excision.</p> <p>2. Sample destaining</p> <p>Exp. 5. In-gel digestion</p> <p>Exp. 6. Analyst software</p> <p>Exp. 7. Manual/ Automatic MS/MS Setup and Data Acquisition</p> <p>Exp. 8. The fragment spectra were match against an NCBI protein sequences database using MASCOT (Matrix Science Ltd.) and identified sequences validated against MS/MS data using BioAnalyst software.</p>			
Plant Photosynthesis and Productivity		2.0	2	
	<p>The physiological and molecular bases of how plants respond to a number of environmental factors will be covered in this class, and how the principles may be exploited for crop improvement will be shown. The subjects covered include: (1) Oxygen stress – production of reactive oxygen species, ozone, damage mechanisms and scavenging systems, (2) Compatible solutes and biosynthesis – kinds of compatible solutes, osmoprotectants, (3) Excess light and UV-light – photoinhibition and photoprotection, (4) Heat stress – heat shock proteins and protective mechanisms, thermostability of proteins at high temperatures and protection, (5) Chilling and freezing stresses - , (6) Salinity stress – ion versus dehydration stress, and (7) Drought stress – osmotic adjustment, and (8) Heavy metal and phytoremediation.</p>			
Transgenic Plants	1	1.0	1	
	<p>The course will provide a broad introduction to plant biotechnology and gene manipulation. The objective of this course is to provide both a conceptual and factual foundation for botanical investigation, interpretation, and understanding.</p>			
Transgenic Plants Laboratory		3.0	1	
	<p>Laboratory exercises are designed to correspond with major lecture topics. Designed to provide the student with the basic principles of gene transformation of plant, including nucleic acid purification, detection of transgene, particle bombardment transient expression assay system and Agrobacteria-mediated transformation.</p>			
Special Topics of Molecular Biology of Agriculture	1	2.0	2	

		1.0	1	
Research Methodology of Agricultural Biotechnology		<p>The course introduce RNA and Protein technologies which are a important parties of biotechnology ◦ The contents:</p> <ol style="list-style-type: none"> 1. Total RNA Extraction and Agarose Gel Electrophoresis of RNA 2. Total RNA Extraction and RNA Quantitation 3. First-Strand cDNA Synthesis and RT-PCR Analysis 4. Particle Bombardment Transient Expression Assay System I 5. Extraction of Plant Tissue Protein , Protein Quantitation , Luciferase and Green Fluorescent Protein (GFP) Assay 6. Particle Bombardment Transient Expression Assay System II 7. GUS Assay and Test 8. Animal tissue protein extraction & quantification 9. Protein 1-D SDS-PAGE <p>Western Blot or discussion and test</p>		
Forum on Translational Agricultural Molecular Biology		2.0	2	
	The distinguished researchers and professional leaders in the field of translational agricultural molecular biology will be invited to give a specific lecture each week.			
Orchid Biotechnology	1	2.0	2	
	The course only introduces biotechnological tools, physiological phenomenon, and cultivation managements for orchid studies. It contains a broad scale of topics presented by scholars and experts. The topics have pathogen regulations and production, flower organ development, chloroplast genome structure, breeding, genetics, molecular identification, plant transformation, photosynthesis, and cultivar patent protection. These information is useful for students to know how to utilize available strategies in orchid or other crop production.			
Epigenetics	2	1.0	1	
	To provide an overview of the epigenetic mechanisms and their link to chromatin dynamics. The different functions of the nucleus involving the genome and its organization will be discussed with an emphasis on the technological limits and the new experimental approaches developed today. Links between the disruption of nuclear function and the development of human pathologies will be presented.			
Molecular Breeding	2	2.0	2	

	<p>This course is needed to extend knowledge for traditional breeding. Due to the new development and discovery of molecular biology, it creates a lot of molecular information such as DNA sequence data. Those data is really helpful and can be adopted for assisting crop breeding. The molecular information can be utilized for quantitative trait loci mapping and marker selection. These studies can provide a shortcut to accelerate breeding duration and efficiency. Therefore, it is a very important course for agricultural students to understand how to use modern molecular research for improving agricultural traits of crop plants such as rice, maize, orchid, vegetable, and soybean.</p>			
Signal Transduction of Biology	2	2.0	2	
Plant Molecular Stress Physiology	<p>The lecture will provide a broad introduction to the signal transduction of biology. The objective of this course is to provide both a conceptual and factual foundation for biological investigation, interpretation, and understanding. The student will be introduced to the basic principle of biological signals and their roles in controlling the gene expression and regulation in cell growth and development. This course is intended to provide a foundation for further study in life sciences.</p> <p>In this class, the basic mechanisms of different photosynthetic modes in crop plants will be introduced, and how the different mechanisms may influence the crop productivity will be assessed, and how the photosynthetic mechanisms of crop plants may be genetically manipulated for increased productivity. The subjects include: (1) History of photosynthesis research, (2) Photosynthesis - climate and evolution, (3) Photochemistry - light, PSI and PSII, electron transport efficiency, (4) Photoinhibition and photoprotection, (5) UV-B radiation – damage, defense and repair mechanisms, (7) C₃ photosynthesis – Rubisco, CO₂ and O₂ specificity, (8) C₄ photosynthesis, (9) Crussulacean Acid Metabolism, (10) Physiological and ecological analysis among different photosynthetic types, (11) Impact of global warming, (12) Genetic manipulation for enhanced photosynthesis and productivity.</p>			
Writing of Scientific Papers	2	2.0	2	

	<p>In this class, the techniques to write a scientific paper will be covered. The subjects covered include: (1) Preliminaries - scientific writing, perspectives, writing project, scientific paper, (2) Ethics in scientific publishing, (3) How to submit your manuscript, (4) Preparing the text - authorship, title, abstract, introduction, materials and methods section, results, discussion, acknowledgements, references, (3) Preparing the tables and figures - effective tables, graphs, and photographs, (4) Publishing the paper - rights, permission, review process, galley proof, (5) Other writing - review paper, book review, editorials, letter to the editor, (6) Conference communications – oral presentation, poster, conference report, (7) Scientific style - use and misuse of English, jargons, abbreviations, writing across cultures and media, (8) Other forms in scientific communication - thesis, curriculum vitae, grant proposal, progress report, recommendation letter, peer review.</p>			
Advanced Cell Biology	2	2.0	2	
	<p>Cells are the smallest units of organisms. By using microscopic observation, the cellular structure can be revealed. By using cell culture, the cell can be isolated and proliferated in a specified medium. The cellular organelles and useful molecules can be isolated and characterized by breaking down the cells. Researches on cell biology can provide valuable insights regarding cell's proliferation, differentiation, functions, and communication.</p>			
Transgenic Animals	2	2.0	2	
	<p>Course lectures will initiate at the basic genetics, genomic structure, and techniques for molecular genetics, and accordingly teach the procedures for transgenic animals. Lastly, the current application and limitation of transgenic animals will be introduced too.</p>			
Gene Expression and Regulation	2	2.0	2	

	<p>The course covers many topics about how a gene can be regulated and turned on and off. It contains many topics as indicated: 1. Overview of regulation of gene expression; 2.RNA polymerases; 3. Basal factors recognize promoters and assemble the pre-initiation transcription complexes; 4. Gene-specific transcription factors; 5. Co-activators: Interface between gene-specific and basal transcription factors; 6. Control of RNA elongation and termination; 7. RNAPI and RNAPIII transcriptional machineries; 8. Chromatin structure on gene expression; 9. Nuclear matrix, chromosome scaffolds and transcriptional factors; 10. Gene expression dynamics and global genome transcription patterns.</p>			
Gene and Development	2	2.0	2	
	<p>In this course, students should learn the molecular and genetic mechanism of organogenesis of embryo, the development of stem cell biology, the relationship of the apoptosis and epigenetics with development, and the aberrant development leading to cancer.</p>			
Cellular Immunology	2	2.0	2	
	<p>Initially, the various immune systems of living organisms will be introduced. The development and functions of the immune cells and effectors in the defense system will be addressed in details. Applications of immunology to treat cancers, viral, and bacterial infections are also covered.</p>			
Protein Chemistry	2	2.0	2	
	<p>This course will teach the cellular, chemical, physical (thermodynamic), and genetic backgrounds to protein and the overarching principle of protein evolution—the development over generations of the properties of living cells. As you study through the course, you may find it helpful to refer back to this book at intervals to refresh your memory of this background material.</p>			
Plant Biotechnology	2	2.0	2	
	<p>The course will provide a broad introduction to plant biotechnology and gene manipulation. The objective of this course is to provide both a conceptual and factual foundation for botanical investigation, interpretation, and understanding.</p>			
Special Topics of Agricultural Biotechnology	2	2.0	2	
First Academic Year				

Selective Required				
Courses	Session	Teaching Hours	Credit Points	Ref.
Total			64	
Total Credit Points of the First Academic Year			68	

Second Academic Year

Compulsory Required				
Courses	Session	Teaching Hours	Credit Points	Ref.
Seminar (III)	1	3.0	1	
Seminar (IV)		3.0	1	
Total			2	
Selective Required				
Courses	Session	Teaching Hours	Credit Points	Ref.
Bioinformatics	1	2.0	2	
	The course teaching student 1. DNA sequencing and blast, alignment. 2. Application of LC/MS/MS in protein sequencing and mass spectrometry, search in mascot database. 3. Microarray data processing, and using software in gene annotation, clustering and metabolomics. 4. Prediction of protein structure and function in dry lab.			
Advanced Plant Cell and Tissue Culture	1	2.0	2	
Animal Reproduction Technology	1	2.0	2	
	This course will introduce students to the basic reproduction physiology of experimental animal, the animal reproduction characteristics and some modern in vitro techniques that promote animal reproduction			
Molecular Biology of Strees Responses	2	2.0	2	

	2	2.0	2	
Advanced Endocrinology	<p>The major glands of endocrines will be introduced. The known functions of endocrines are addressed in details. This course also emphasizes the interactions among endocrines.</p>			
	2	2.0	2	
Advanced Immunology	<p>Initially, the different immune systems of living organisms will be introduced. The development and functions of the immune cells and effectors in the defense system will be addressed in details. Applications of immunology to treat cancers, viral, and bacterial infections are also covered.</p>			
	2	2.0	2	
Advanced Virology	<p>The criteria to classify viruses will be introduced. The proliferation, life cycle, and pathogenic pathway of each viral class will be addressed. The applications of virology to understand the virus and to prevent viral infection are also covered.</p>			
	2	2.0	2	
Animal Embryology	<p>This course will teach students the entire processes of animal embryogenesis that will included <u>gametogenesis</u> (the maturation of sperms and eggs), fertilization (sperm and egg meet in the reproductive tract to form embryo), <u>cleavage</u> (the fertilized eggs divide), gastrulation (the embryo shapes change to form three germ layers), neurulation (organogenesis starts).</p>			
			Total	16
Total Credit Points of the Fourth Academic Year				20

Second Academic Year				
Dissertation				
Courses	Session	Teaching Hours	Credit Points	Ref.
Thesis	2	6.0	6	
Total			6	
Total Credit Points of the Fourth Academic Year			24	