JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Faculty 09

Winter Semester 2025/26

As of 18.08.2025

Module Directory

Faculty 09 - Agricultural Sciences, Nutritional Sciences and Environmental Management

"Agrobioinformatics" Master Degree Course Modules

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http://www.uni-giessen.de/cms/fbz/fb09/studium/msc/stpl

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Core Modules

MK-002-EN	MK-002-EN Applied Statistics **Applied Statistics**	6 CP
Core Module / Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding II Offered for the first time: WS 2015/16 Intake capacity: not limited	1. Sem.;

Frequency and Duration: WS, 1 semester

Module Coordinator: Chair of Biometry and Population Genetics

Applies to the Study Programmes: Agrobiotechnology, Master (1.); Insect Biotechnology and Bioresources, Master (1.); Agrobioinformatics, Master (1.);

Prerequisites for Participation: None

Learning Outcomes:
The Students
- have knowledge of statistical methods;
- have knowledge of experimental designs;
- are able to analyse experiments and studies.

Module Content:
- Analysis of variance
- Comparison of treatments
- Mixed linear models
- Experimental designs
- Data analysis using statistical software

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar		
Practical training	30	60
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Assignments (4) or written examination
- Components of final grade: Assignments (100 %) or written examination (100 %)
- Form of module retake examination: Written examination

Language: English

<table>
<tr><td rowspan="2">MK-116-EN</td><td>MK-116-EN Principles of Scientific Practice</td><td rowspan="2">6 CP</td></tr>
<tr><td>Principles of Scientific Practice</td></tr>
<tr><td rowspan="3">Core Module /
Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management /
Department of Agronomy and Plant Breeding I</td><td rowspan="3">1. Sem.;
2. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2021</td></tr>
<tr><td>Intake capacity: not limited</td></tr>
<tr><td colspan="3">Frequency and Duration: WS and SS, 1 Semester</td></tr>
<tr><td colspan="3">Module Coordinator: Chair of Agrobioinformatics</td></tr>
<tr><td colspan="3">Applies to the Study Programmes: Agrobiotechnology, Master (1.); Insect Biotechnology and Bioresources, Master (2.); Agrobioinformatics, Master (1.);</td></tr>
<tr><td colspan="3">Prerequisites for Participation: None</td></tr>
<tr><td colspan="3">Learning Outcomes:
The students
understand principles of scientific methods, scientific recording and scientific reporting;
are able to formulate testable research hypotheses and design experiments to answer scientific questions;
understand requirements and reporting standards for statistical analysis;
understand how to generate and communicate scientific knowledge;
are familiar with guidelines for good scientific practise;
are able to locate reliable, quality-assured information representing the accepted status quo in regard to a specific scientific question;
are able to correctly use and cite scientific sources in written work and presentations.</td></tr>
<tr><td colspan="3">Module Content:
Scientific methods
Scientific hypotheses
Experimental design
Generation, recording and communication of scientific knowledge
Good scientific practice
Types and sources of scientific information</td></tr>
</table>

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar	10	20
Practical training		
Exercises	20	40
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:

- Form(s) of assessment: Assignment (9 tasks), oral presentation (15 - 20 min.) and written assignment (2500 - 3000 words) or written examination or oral examination
- Components of final grade: Assignment (25 %), oral presentation (25 %) and written assignment (50 %) or written examination (100 %) or oral examination (100 %)
- Form of module retake examination: Revision of the written assignment or written examination or oral examination

Language: English

<table>
<tr><td rowspan="2">MK-128-EN</td><td>MK-128-EN Analysis of DNA and RNA Sequencing Data</td><td rowspan="2">6 CP</td></tr>
<tr><td>Analysis of DNA and RNA Sequencing Data</td></tr>
<tr><td rowspan="3">Core Module / Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I</td><td rowspan="3">1. Sem.;</td></tr>
<tr><td>Offered for the first time: WS 2024/25</td></tr>
<tr><td>Intake capacity: 30</td></tr>
</table>

Frequency and Duration: WS, 1 Semester

Module Coordinator: Chair of Agrobioinformatics

Applies to the Study Programmes: Agrobioinformatics, Master (1.);

Prerequisites for Participation: None (recommended: Knowledge of molecular genetics)

Learning Outcomes:
The students
- are familiar with sequencing technologies for DNA (DNA-Seq) and RNA (RNA-Seq) data generation;
- understand differences between DNA-Seq and RNA-Seq data;
- know key steps and methods involved in genome assembly;
- know principles of structural genome annotation;
- are familiar with key comparative genomics concepts including synteny and pangenome;
- know types, sources and methods for identification of genomic sequence variation;
- know different types of RNA-Seq data normalization;
- understand the principles of differential gene expression analysis;
- are familiar with potential of deep learning for gene expression prediction;
- understand principles of multi-omic data integration for genome functional annotation.

Module Content:
- Methods and technologies for genomic/transcriptomic data generation, analysis and integration
- Analysis of DNA sequencing data: genome assembly, genome structural annotation, comparative genomics, genomic variant identification
- Analysis of RNA sequencing data: RNA-Seq data quality control, normalisation methods, differential gene expression analysis, gene expression prediction

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	40	80
Seminar	20	40
Practical training		
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Seminar paper (2 pages) and oral examination
- Components of final grade: Seminar paper (40 %), oral examination (60 %)
- Form of module retake examination: Oral examination

Language: English

<table>
<tr><td rowspan="2">MK-129-EN</td><td>MK-129-EN Python Programming for Bioinformatics</td><td rowspan="2">6 CP</td></tr>
<tr><td>Python Programming for Bioinformatics</td></tr>
<tr><td rowspan="3">Core Module / Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I</td><td rowspan="3">2. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2026</td></tr>
<tr><td>Intake capacity: 30</td></tr>
</table>

Frequency and Duration: SS, 1 Semester

Module Coordinator: Chair of Agrobioinformatics

Applies to the Study Programmes: Agrobioinformatics, Master (2.);

Prerequisites for Participation: None

Learning Outcomes:
Students
- understand and use variables, control structures, functions, Python data structures, error handling, and reading/writing bioinformatics files;
- are familiar with external bioinformatics Python packages (e.g., Biopython);
- are able to perform key bioinformatics tasks (e.g., reading and writing biological sequences, converting file formats, conducting differential gene expression analysis).

Module Content:
- The significance of computer programming in modern biological and agricultural research
- Independent programming tasks using numbers, strings, conditional statements, loops, file input/output, and error handling
- Application of Python in practical bioinformatics tasks

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	40	80
Seminar		
Practical training	20	40
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Assignents (four) and written examination
- Components of final grade: Assignents (50 %), written examination (50 %)
- Form of module retake examination: Written examination

Language: English

<table>
<tr><td rowspan="2">MK-130-EN</td><td>MK-130-EN Genetics of Crop Diversity</td><td rowspan="2">6 CP</td></tr>
<tr><td>Genetics of Crop Diversity</td></tr>
<tr><td rowspan="3">Core Module / Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I</td><td rowspan="3">1. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2025</td></tr>
<tr><td>Intake capacity: 24</td></tr>
</table>

Frequency and Duration: WS, 1 Semester

Module Coordinator:

Applies to the Study Programmes: Agrobioinformatics, Master (1.);

Prerequisites for Participation: None (recommended: knowledge of plant breeding and genetics, basic statistics)

Learning Outcomes:

The students

- have a broad understanding of the importance, the generation and the impact of genetic variation on different regulatory levels;
- are familiar with the significance, mission, and operation of gene banks;
- possess detailed knowledge of conventional and biotechnological mutation processes;
- are familiar with methods for identifying and screening genetic variation;
- know relevant approaches for linking genetic variation with phenotypic diversity;
- have theoretical and practical knowledge of sequence analysis and diversity analysis;
- possess comprehensive knowledge of the legal framework for the use and creation of genetic variation.

Module Content:

- Importance of genetic diversity in plant breeding and evolution
- Significance and conservation of genetic resources
- Fundamentals and methods for identifying sequence variation, structural genome variation, epigenetic variation, and variation in gene expression
- Basics of mutation breeding, genetic engineering, and genome editing
- Methods for linking genetic variation with phenotypic diversity (association analysis, deductive methods)
- Fundamentals of the legal situation regarding the use of genetic resources and the creation of directed variation
- Excursion to the gene bank at IPK Gatersleben
- Practical training: greenhouse experiment, laboratory practical, data analysis

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	46	70
Seminar		
Practical training	14	40
Exercises		
Excursion	10	
Total:	180	

Prerequitistes for Examination: None

Module Examination:

- Form(s) of assessment: Written examination and presentation (15 min.)
- Components of final grade: Written examination (75 %), presentation (25 %)
- Form of module retake examination: Written examination and written assignment (5-10 pages)

Language: English

<table>
<tr><td rowspan="2">MK-131-EN</td><td>MK-131-EN Gene Expression Analysis and Systems Biology</td><td rowspan="2">6 CP</td></tr>
<tr><td>Gene Expression Analysis and Systems Biology</td></tr>
<tr><td rowspan="3">Core Module / Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I</td><td rowspan="3">2. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2026</td></tr>
<tr><td>Intake capacity: 40</td></tr>
<tr><td colspan="3">Frequency and Duration: SS, 1 Semester</td></tr>
<tr><td colspan="3">Module Coordinator:</td></tr>
<tr><td colspan="3">Applies to the Study Programmes: Agrobioinformatics, Master (2.);</td></tr>
<tr><td colspan="3">Prerequisites for Participation: None</td></tr>
<tr><td colspan="3">Learning Outcomes:
Students
have an in-depth understanding of the biological significance of different RNA classes and the resulting polypeptides, as well as of gene regulation mechanisms, and are aware of the types of biological questions that can be addressed using gene expression data;
are familiar with the principles of RNA sequencing and downstream data analysis and understand the basics of other omics-based datasets;
have solid knowledge of PCR-based methods for gene expression analysis;
are aware of typical sources of error and limitations of both approaches;
possess extensive theoretical and practical knowledge of performing weighted gene co-expression network analysis (WGCNA) in the context of systems biology;
are able to critically evaluate scientific literature related to gene expression analysis and WGCNA.</td></tr>
<tr><td colspan="3">Module Content:
Overview of the different pathways of gene expression and RNA classes
Principles of gene regulation illustrated by specific situations (e.g., developmental transitions such as germination and flowering, abiotic stress, pathogen response)
RNA sequencing methods and data analysis approaches
Overview of omics technologies (genomics, epigenomics, proteomics, metabolomics, phenomics) and the characteristics of their associated datasets
Principles and methods of RT-qPCR
Fundamentals of systems biology in general, and weighted gene co-expression network analysis (WGCNA) in particular
Gene clustering
The concept of the eigengene
Correlative trait analysis
Functional analysis (GO terms and KEGG analysis)
Practical exercise on performing WGCNA
Interpretation of a scientific publication</td></tr>
</table>

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	40	80
Seminar		
Practical training		
Exercises	20	40
Excursion		
Total:	180	
Prerequitistes for Examination: None		
Module Examination: • Form(s) of assessment: Written assignment (Paper; 8-15 pages) • Components of final grade: Written assignment (100 %) • Form of module retake examination: Revision of the written assignment		
Language: English		

MK-133-EN	MK-133-EN Biodiversity Monitoring with Molecular Tools **Biodiversity Monitoring with Molecular Tools**	6 CP
Core Module / Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Insect Biotechnology Offered for the first time: SS 2021 Intake capacity: 30	2. Sem.;

Frequency and Duration: SS, 1 Semester

Module Coordinator: Chair of Sustainable and Functional Animal Nutrition

Applies to the Study Programmes: Agrobioinformatics, Master (2.);

Prerequisites for Participation: None (recommended: basic understanding of laboratory methods in molecular ecology, basic knowledge of R)

Learning Outcomes:
The students
- understand the main genomic approaches for biomonitoring;
- can design and evaluate a simple DNA-based biomonitoring experiment.

Module Content:
- relevant genomic approaches for evaluating biodiversity loss
- experimental design
- sampling ecological communities and processing bulk DNA samples through metabarcoding or metagenomics
- bioinformatics and statistics of high-throughput DNA sequence data
- interpretation of results

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	10	40
Seminar	5	20
Practical training	45	60
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Presentation (10 - 15 min) and written examination
- Components of final grade: Presentation (30%) written examination (70%)
- Form of module retake examination: written examination or oral exam

Language: English

MK-134-EN	MK-134-EN Statistical Learning and Neural Networks **Statistical Learning and Neural Networks**	6 CP
Core Module / Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding II Offered for the first time: SS 2025 Intake capacity: not limited	2. Sem.;

Frequency and Duration: SS, 1 Semester

Module Coordinator: Chair of Biometry and Population Genetics

Applies to the Study Programmes: Agrobioinformatics, Master (2.);

Prerequisites for Participation: Aplied Statistics (MK-002 or MK-002-EN)

Learning Outcomes:
The Students
- know important methods of statistical learning;
- understand their mathematical and probability theoretical basics;
- can apply statistical learning methods to data sets.

Module Content:
- Prediction models for qualitative variates
- Prediction models for quantitative variates
- Model selection
- Resampling methods

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar		
Practical training	30	60
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Working on tasks (4 tasks) or written examination
- Components of final grade: Working on tasks (100 %) or written examination (100%)
- Form of module retake examination: Written examination

Language: English

<table>
<tr><td rowspan="2">MK-135-EN</td><td>MK-135-EN Analysis of Diversity and Traits in Farm Animals</td><td rowspan="2">6 CP</td></tr>
<tr><td>Analysis of Diversity and Traits in Farm Animals</td></tr>
<tr><td rowspan="3">Core Module / Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Animal Breeding and Genetics</td><td rowspan="3">1. Sem.;</td></tr>
<tr><td>Offered for the first time: WS 2025/26</td></tr>
<tr><td>Intake capacity: not limited</td></tr>
</table>

Frequency and Duration: WS, 1 Semester

Module Coordinator: Chair of Animal and Pathogenetics

Applies to the Study Programmes: Agrobioinformatics, Master (1.);

Prerequisites for Participation: None

Learning Outcomes:
The students
- understand the background and reasons for genomic analysis of diversity and traits in farm animals;
- are familiar with genomic tools for diversity and trait analysis in farm animals;
- have practical knowledge on how to use selected genomic tools for diversity and trait analysis using datasets from farm animals (e.g. R and PLINK).

Module Content:
- introduction on importance and actual situation of genetic diversity in farm animals
- methods and available tools for diversity analysis
- practical application of selected tools for analysis of genetic diversity in datasets from farm animals
- background on inheritance and phenotyping of traits in farm animals
- methods and available tools for analysis of traits in farm animals
- practical application of selected tools for traits analysis in datasets from farm animals

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar		
Practical training	20	40
Exercises	10	20
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Assignments (4-6, Processing time: 15-30 min. each)
- Components of final grade: Assignments (100 %)
- Form of module retake examination: Written examination or oral exam

Language: English

<table>
<tr><td rowspan="2">MK-136-EN</td><td>MK-136-EN Plant Breeding Principles and Methods</td><td rowspan="2">6 CP</td></tr>
<tr><td>Plant Breeding Principles and Methods</td></tr>
<tr><td rowspan="3">Core Module / Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I</td><td rowspan="3">2. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2026</td></tr>
<tr><td>Intake capacity: not limited</td></tr>
</table>

Frequency and Duration: SS, 1 Semester

Module Coordinator: Chair of Plant Breeding

Applies to the Study Programmes: Agrobioinformatics, Master (2.);

Prerequisites for Participation: None (recommended: prior knowledge in molecular genetics)

Learning Outcomes:
Students
- have fundamental and advanced knowledge of plant breeding, Einladung the objectives and strategies of breeding programs;
- are familiar with key breeding methods used for major European crops and are able to apply them;
- are familiar with modern technologies aimed at increasing genetic gain and can evaluate their potential use in breeding programs;
- have insight into the structures, processes, and framework conditions of commercial plant breeding.

Module Content:
- Fundamentals of plant breeding
- Plant varieties and variety registration procedures
- Genetic diversity and heritability
- Breeding methodology in relation to floral biology
- Design of field trials and use of mixed linear models for analyzing experimental data
- Breeding case studies of major European crops
- Modern innovations to enhance genetic gain in crop plants

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar		
Practical training	20	40
Exercises		
Excursion	10	20
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Oral examination or written examination
- Components of final grade: Oral examination (100 %) or written examination (100 %)
- Form of module retake examination: Oral examination or written examination

Language: English

Profile Modules

MK-015-EN	MK-015-EN Plant Protection and Bioengineering **Plant Protection and Bioengineering**	6 CP
Core Module / Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Phytopathology Offered for the first time: WS 2015/16 Intake capacity: not limited	1./2. Sem.; 3./4. Sem.;

Frequency and Duration: WS, 1 Semester

Module Coordinator: Chair of Phytopathology

Applies to the Study Programmes: Agrobiotechnology, Master (1./2.);

Prerequisites for Participation: None (recommended: Basic knowledge in plant pathology and molecular biology)

Learning Outcomes:
The Students
- are able to understand and evaluate industrial strategies for disease control;
- have experience with basic biotechnological processes, such as tissue culture, high-throughput screening and pesticide applications;
- have a conception of the implementation impacts of plant biotechnology;
- have a command of the most important transformation techniques in the production of genetically modified plants;
- have a theoretical background of the biological mechanismus modern plant protection is based on.

Module Content:
- transgenic plants
- agronomically significant genes
- biotechnological disease control techniques
- tissue techniques and tissue cultures
- high-throughput screening methods
- industrial strategies in plant protection

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	40	70
Seminar	30	40
Practical training		
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Written examination and presentation (10-20 min.)
- Components of final grade: Written examination (75 %) and presentation (25 %)
- Form of module retake examination: Oral examination or written examination

Language: English

MK-016-EN	MK-016-EN Biotechnology and Genomics **Biotechnology and Genomics**	6 CP
Core Module / Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I Offered for the first time: SS 2016 Intake capacity: not limited	2. Sem.;

Frequency and Duration: SS, 1 Semester

Module Coordinator: Chair of Plant Breeding

Applies to the Study Programmes: Agrobiotechnology, Master (2.);

Prerequisites for Participation: None (recommended: Knowledge of molecular genetics)

Learning Outcomes:
The students
- have deep theoretical knowledge about genome analysis methods methods, with an emphasis on plant genome mapping and gene expression techniques;
- gain insight into the practical applications of biotechnological and molecular genetic methods in plant breeding;
- have the necessary theoretical background to apply experimental molecular genetics, biotechnological and gene technological methods in plant breeding.

Module Content:
- Molecular and cellular plant genetics
- Methods and techniques of experimental biotechnology and genome analysis
- Molecular plant breeding: Structure and function of plant genomes, molecular markers, genome mapping, QTL analysis, gene cloning techniques, gene expression methodology
- Methods of gene technology in plant breeding: Gene isolation, gene transfer (transformation techniques), detection methods

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	50	90
Seminar		
Practical training		
Exercises		
Excursion	20	20
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Written examination and seminar paper (4 pages)
- Components of final grade: Written examination (80%), seminar paper (20%)
- Form of module retake examination: Written examination

Language: English

MK-119-EN	MK-119-EN Population Genetics **Population Genetics**	6 CP
Core Module / Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding II Offered for the first time: SS 2016 Intake capacity: not limited	1./2. Sem.; 3./4. Sem.;

Frequency and Duration: WS, 1 Semester

Module Coordinator: Chair of Biometry and Population Genetics

Applies to the Study Programmes: Nutzpflanzenwissenschaften, Master (1./2.);

Prerequisites for Participation: None

Learning Outcomes:
The students
- know important population genetical models;
- are able to analyse population genetical data;
- are able to model and simulate population genetical processes.

Module Content:
- Models for single loci: genotype and allele frequencies, inbreeding, drift, selection
- Models for several loci: genetic maps, linkage disequilibrium
- Models for populations: genetic distances and visualization
- Genome wide association studies

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar		
Practical training	30	60
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Assignments (4) or written examination
- Components of final grade: Assignments (100 %) or written examination (100%)
- Form of module retake examination: Written examination

Language: English

MP-076-EN	MP-076-EN Lab Course: Tissue Culturing and Genetic Transformation **Lab Course: Tissue Culturing and Genetic Transformation**	6 CP
Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Phytopathology Offered for the first time: WS 2015/16 Intake capacity: 30	1./3. Sem.; 3./4. Sem.;

Frequency and Duration: WS, Block, 1 Semester

Module Coordinator: Chair of Phytopathology

Applies to the Study Programmes: Profil, Master (1./3.); Profil englisch, Master (1./3.);

Prerequisites for Participation: Molecular Phytopathology (MK 057), Plant Protection and Bioengineering (MK 015)

Learning Outcomes:
The Students
- have practical knowledge of the methods, strategies, and laboratory techniques for plant and microbe transformation;
- are able to understand technical problems related to genetic transformation of crop plants, and identify the risks involved in this strategy;
- have fundamental knowledge in risk assessment, environment protection, farmer and consumer protection, and food security.

Module Content:
- guidance for the risk management of genetic engineered plant and microorganisms
- practical training in plant transformation
- practical training in microbe transformation techniques
- practical training in tissue culturing techniques
- practical training in detection of transgenes by molecular and cell biology techniques
- practical training in confocal laser microscopy
- practical training in transgene function assessment

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	5	10
Seminar	5	10
Practical training	50	100
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Oral examination, seminar paper (8 pages)
- Components of final grade: Oral examination (50%), seminar paper (50%)
- Form of module retake examination: Oral examination

Language: English

MP-098-EN	MP-098-EN Molecular Plant Breeding **Molecular Plant Breeding**	6 CP
Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I Offered for the first time: WS 2015/16 Intake capacity: 30	1.-4. Sem.; 3./4. Sem.;

Frequency and Duration: WS, 1 Semester

Module Coordinator: Chair of Plant Breeding

Applies to the Study Programmes: Profil, Master (1.-4.); Profil englisch, Master (1.-4.);

Prerequisites for Participation: Biotechnology and Genomics (MK 016) / (recommended: Plant Breeding: Special Topics of Resistance and Quality Breeding (MP 020))

Learning Outcomes:
The students
- will gain practical and/or theoretical experience in DNA and RNA extraction and analysis techniques, PCR, genetic mapping and QTL analysis, DNA hybridisation, gene expression and next-generation sequencing
- will learn practical applications of biotechnological and molecular genetic methods in plant breeding
- will obtain the necessary practical background to apply experimental molecular genetics, biotechnological and gene technological methods in plant breeding

Module Content:
- Next-generation DANN sequencing
- Molecular marker analysis, genome mapping and QTL analysis
- DNA filter hybridisation, genome libraries
- Quantitative real-time PCR
- New methods of gene technology in plant breeding: Genome editing, cis-genestics

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	30
Seminar		
Practical training	40	80
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Oral examination and lab book (30-50 pages)
- Components of final grade: Oral examination (50 %), lab book (50 %)
- Form of module retake examination: Oral examination

Language: English

MP-196	MP-196 Internship	12 CP
	Berufspraktikum	
Optional Module	Agricultural Sciences, Nutritional Sciences, and Environmental Management /	1. - 4. Sem.;
	Offered for the first time: WS 2019/20	
	Intake capacity: not limited	

Frequency and Duration: WS and SS, 1 Semester

Module Coordinator: Study deanery

Applies to the Study Programmes: Profil englisch, Master (1. - 4.); Profil, Master (1. - 4.);

Prerequisites for Participation: Keine

Learning Outcomes:
The Students
- gain in-depth experience as interns in future fields of activity and professions;
- have practical knowledge and skills from their internship companies and understand the connection between study and practice;
- concretise their personal career perspectives (career planning).

Module Content:
- Development of future occupational fields
- Practical experience in companies in the fields of agricultural sciences, environmental sciences, ecotrophology and nutritional sciences
- Reflection on one's own practical professional activity

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture		
Seminar		
Practical training	360	
Exercises		
Excursion		
Total:	360	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Internship report (tasks, activities, acquired knowledge and skills, reflection). The report must be assessed as "passed".
- Components of final grade: Formation of the module mark: ungraded performance
- Form of module retake examination: Revision of the internship report

Language: German and/or English

<table>
<tr><td rowspan="2">MP-235-EN</td><td>MP-235-EN Practical Genome Sequencing and Bioinformatics</td><td rowspan="2">6 CP</td></tr>
<tr><td>Practical Genome Sequencing and Bioinformatics</td></tr>
<tr><td rowspan="3">Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding I</td><td rowspan="3">1.-4. Sem.;
3./4. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2022</td></tr>
<tr><td>Intake capacity: 15</td></tr>
</table>

Frequency and Duration: WS and SS, 1 Semester

Module Coordinator: Chair of Agrobioinformatics

Applies to the Study Programmes: Profil, Master (1.-4.); Profil englisch, Master (1.-4.);

Prerequisites for Participation: Biotechnology and Genomics (MK-016-EN)

Learning Outcomes:
The students
- are familiar with practical experimental techniques related to genome sequencing and genomic data analysis;
- know how to extract plant DNA samples and check DNA quality using standard molecular biology techniques;
- know the principles for generating DNA libraries suitable for high-throughput DANN sequencing;
- know how analyse resulting genomic data using bioinformatics methodologies;
- are familiar with the Linux operating system and high performance computing necessary for bioinformatics analysis;
- know the principles of scientific record keeping and lab reporting based on the experiments performed.

Module Content:
- DNA extraction
- DNA quantification using RT-PCR
- Library preparation
- High-throughput DNA sequencing
- Bioinformatics analysis of sequencing data
- Molecular biology quality control techniques (PCR, gel electrophoresis, etc)
- Production of lab books and practical reports

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	10	20
Seminar		
Practical training	50	100
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: Participation in laboratory classes

Module Examination:
- Form(s) of assessment: Seminar paper (3000 words minimum) and lab book (4 to 6 experiments)
- Components of final grade: Seminar paper (60 %), lab book (40 %)
- Form of module retake examination: Revision of seminar paper and lab book

Language: English

<table>
<tr><td rowspan="2">MP-236-EN</td><td>MP-236-EN Quantitative Genetics</td><td rowspan="2">6 CP</td></tr>
<tr><td>Quantitative Genetics</td></tr>
<tr><td rowspan="3">Optional Module</td><td>Agricultural Sciences, Nutritional Sciences, and Environmental Management / Department of Agronomy and Plant Breeding II</td><td rowspan="3">1.-4. Sem.;
3./4. Sem.;</td></tr>
<tr><td>Offered for the first time: SS 2022</td></tr>
<tr><td>Intake capacity: not limited</td></tr>
</table>

Frequency and Duration: SS, 1 Semester

Module Coordinator: Chair of Biometry and Population Genetics

Applies to the Study Programmes: Profil englisch, Master (1.-4.); Profil, Master (1.-4.);

Prerequisites for Participation: None

Learning Outcomes:
The students
- know quantitative genetic models to decompose the genotypic value;
- understand the basics of quantitative inheritance and genome-wide prediction;
- understand models of selection theory;
- can estimate the expected response to selection.

Module Content:
- Additive, dominance, and epistasic effects
- Performance prediction of selection candidates
- Estimation of variance components and heritability
- Direct selection, indirect selection, multistage selection, index selection

Forms of Instruction:	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar		
Practical training	30	60
Exercises		
Excursion		
Total:	180	

Prerequitistes for Examination: None

Module Examination:
- Form(s) of assessment: Assignments (4) or written examination
- Components of final grade: Assignments (100 %) or written examination (100%)
- Form of module retake examination: Written examination

Language: English

M-BS2-MTS7	M-BS2-MTS7 Objektorientierte Programmierung interaktiver Systeme **Object-oriented programming of interactive systems**	3 CP
Wahlpflichtmodul	THM Fachbereich 06 / Mathematik, Naturwissenschaften und Informatik erstmals angeboten im SS 2023	2. Semester 3./4. Sem.;

Angebotsrhythmus und Dauer: SS, 1 Semester

Modulverantwortliche Professur oder Stelle: Professur für Bioinformatik (derzeit: Prof. Dr. F. Cemic)

Verwendbar in folgenden Studiengängen: M.Sc. Bioinformatik/ Systembiologie, 2. Semester, Wahlpflichtmodul; Profil Agrobioinformatics, Master (3./4.);

Teilnahmevoraussetzungen: „Objektorientierte Programmierung“ (M-BS1-ZQ1u2B)

Qualifikationsziele:
Die Studierenden sind in der Lage
- z. T. nebenläufige objektbasierte Programme in einer modernen Programmiersprache mit einfachen bis komplexen graphischen Oberflächen und Datenbankkonnektivität unter Einhaltung softwaretechnischer Prinzipien zu entwickeln sowie
- die Korrektheit ihrer Lösung in systematischen Tests zu überprüfen.

Inhalte:
- Entwicklung graphischer Benutzeroberflächen
- Programmierung einfacher webbasierter Systeme
- Threads
- Datenbankkonnektivität

Veranstaltung:	Präsenzstunden	Vor- und Nachbereitung
Vorlesung	20	20
Exkursion	10	40
Summe:	90	

Prüfungsvorleistungen: Keine

Modulprüfung:
- Prüfung: Übungsaufgaben, 5 Übungsblätter, je 2 Wochen Bearbeitungszeit
- Bildung der Modulnote: Übungsaufgaben (100 %)
- 1. Wiederholungsprüfung: mündliche Prüfung (30 min)
- 2. Wiederholungsprüfung: Siehe § 10 (4)

Unterrichts- und Prüfungssprache: Deutsch und/oder Englisch, wird vor Veranstaltungsbeginn verbindlich festgelegt und bekanntgegeben.

M-BS2-MTS8	M-BS2-MTS8 Mikrobiom- Datenanalyse Microbial Data Analysis	3 CP
Wahlpflichtmodul	Fachbereich 08 / Biologie / Algorithmische Bioinformatik erstmals angeboten im SS 2023	2. Semester 3./4. Sem.;

Angebotsrhythmus und Dauer: SS, 1 Semester

Modulverantwortliche Professur oder Stelle: Professur für Algorithmische Bioinformatik (derzeit: Prof. Dr. Stefan Janssen)

Verwendbar in folgenden Studiengängen: M.Sc. Bioinformatik/ Systembiologie, 2. Semester, Wahlpflichtmodul; Profil Agrobioinformatics, Master (3./4.);

Teilnahmevoraussetzungen: keine

Qualifikationsziele:
Die Studierenden
- sind mit den theoretischen Grundlagen und praktischen Designentscheidungen der Mikrobiom-Analyse vertraut;
- sind in der Lage notwendige Analysesoftware zu installieren und zu verwenden;
- beherrschen reproduzierbare Analysewerkzeuge zur Dokumentation und Ausführung;
- kennen gängige Mikrobiom Datenbanken;
- sind vertraut mit Diversitätsmaßen zur Quantifizierung von Mikrobiom-Unterschieden;
- sind in der Lage, Feature-Tabellen zu erstellen und taxonomische Namen für Features vorherzusagen;
- sind vertraut mit grundlegenden statistischen Tests und interaktiver Datenvisualisierung.

Inhalte:
Das Mikrobiom ist die ökologische Gemeinschaft von kommensalen, symbiotischen und pathogenen Mikroorganismen, die in und auf allen mehrzelligen Organismen von Pflanzen bis zu Tieren zu finden sind. Es umfasst Bakterien, Archaeen, Protisten, Pilze und Viren. Es wurde festgestellt, dass das Mikrobiom entscheidend für die immunologische, hormonelle und metabolische Homöostase seines Wirts ist, z. Typ-1- Diabetes, Morbus Crohn, Parkinson, Fettleibigkeit, Depression etc. Dieses Seminar behandelt Schritt für Schritt alle notwendigen Prozessierungsschritte, um ein typisches Mikrobiom-Experiment zu verarbeiten und zu analysieren. Wir konzentrieren uns auf 16S rRNA Amplikon Daten – sequenziert z.B. über Illumina – und Analysetools meist aus der Qiime2-Platform. Wir beginnen mit der Kuration von Sequenz- und Metadaten, fahren fort mit OTU / ASV-Auswahl, Diversitätsberechnung, Taxonomiezuordnung und interaktiver Datenexploration, bevor wir zu statistischen Tests, differentieller Abundanz-, Korrelations- und Konkurrenzanalyse übergehen. Bei Interesse können eigene Daten mitgebracht werden – dies ist aber keine Voraussetzung! Alle vorgestellten Techniken werden in interaktiven praktischen Sitzungen erkundet.

Veranstaltung:	Präsenzstunden	Vor- und Nachbereitung
Seminar	15	10
Praktikum	15	50
Summe:	90	

Prüfungsvorleistungen: siehe §°7 SpezO .MSc. Bioinformatik / Systembiologie

Modulprüfung:
- Prüfung: Bericht (5-10 Seiten) zum Praktikum und Präsentation (Seminarvortrag oder Posterpräsentation, 15-20 min) zum Seminar
- Bildung der Modulnote: Bericht (30 %), Präsentation (70 %)
- 1. Wiederholungsprüfung: mündliche Prüfung (30 min)
- 2. Wiederholungsprüfung: Siehe § 10 (4)

Unterrichts- und Prüfungssprache: Deutsch und/oder Englisch, wird vor Veranstaltungsbeginn verbindlich festgelegt und bekanntgegeben.

<table>
<tr><td rowspan="2">M-BS2-S4A</td><td>M-BS2-S4A Hochdurchsatzdatenanalyse Teil 1</td><td rowspan="2">6 CP</td></tr>
<tr><td>Analysis of High-Throughput Data Part 1</td></tr>
<tr><td rowspan="2">Wahlpflichtmodul</td><td>Fachbereich 08 / Biologie / Systembiologie</td><td rowspan="2">2. Semester
3./4. Sem.;</td></tr>
<tr><td>erstmals angeboten im SS 2023</td></tr>
</table>

Angebotsrhythmus und Dauer: SS, 1 Semester

Modulverantwortliche Professur oder Stelle: Professur für Systembiologie (derzeit: Prof. Dr. A Goesmann)

Verwendbar in folgenden Studiengängen: M.Sc. Bioinformatik/ Systembiologie, 2. Semester, Wahlpflichtmodul; Profil Agrobioinformatics, Master (3./4.);

Teilnahmevoraussetzungen: keine

Qualifikationsziele:
Die Studierenden

- verfügen über praktische Kenntnisse zur automatisierten Verarbeitung und Analyse von Hochdurchsatzdaten;
- können die Grundlagen der in Hochdurchsatztechnologien angewandten statistischen und bioinformatische Methoden verstehen und anwenden;
- verfügen über Kenntnisse von effizienten Datenstrukturen in Hochdurchsatztechnologien;
- sind in der Lage, kritisch mit Hochdurchsatzdaten umzugehen und können diese effizient
- analysieren und modellieren;
- können für verschiedene Hochdurchsatzdaten angepasste Analyse-Workflows entwerfen und implementieren.

Inhalte:

- Praktische Bearbeitung und Aufarbeitung von Rohdaten aus Hochdurchsatzanalysen
- Erstellung von Analyse-Pipelines bzw. die Anwendung publizierter Analyse-Pipelines zur Erfassung, Qualitätskontrolle und Prozessierung von Hochdurchsatzdaten
- Aktuelle, in der Hochdurchsatzdatenanalyse verbreitete Workflow-Systeme
- Modellierung und Interpretation der funktionellen Zusammenhänge anhand der Ergebnisse aus Hochdurchsatzanalysen
- Öffentliche Datenbanken zur Speicherung von Hochdurchsatzdaten und deren Schnittstellen/ Data-mining

Veranstaltung:	Präsenzstunden	Vor- und Nachbereitung
Vorlesung	40	40
Übung	40	60
Summe:	180	

Prüfungsvorleistungen: siehe §°7 SpezO .MSc. Bioinformatik / Systembiologie

Modulprüfung:

- Prüfung: Klausur (120 min) oder mündliche Prüfung (30-40 min)
- Bildung der Modulnote: Klausur oder mündliche Prüfung (100 %)
- 1. Wiederholungsprüfung: Klausur (120 min) oder mündliche Prüfung (30-40 min)
- 2. Wiederholungsprüfung: Siehe § 10 (4)

Unterrichts- und Prüfungssprache: Deutsch und/oder Englisch, wird vor Veranstaltungsbeginn verbindlich festgelegt und bekanntgegeben.

M-BS2-S4B	M-BS2-S4B Hochdurchsatzdatenanalyse Teil 2 Analysis of High-Throughput Data Part 2	6 CP
Wahlpflichtmodul	Fachbereich 08 / Biologie / Systembiologie erstmals angeboten im SS 2023	2. Semester 3./4. Sem.;

Angebotsrhythmus und Dauer: SS, 1 Semester

Modulverantwortliche Professur oder Stelle: Professur für Systembiologie (derzeit: Prof. Dr. A Goesmann)

Verwendbar in folgenden Studiengängen: M.Sc. Bioinformatik/ Systembiologie, 2. Semester, Wahlpflichtmodul; Profil Agrobioinformatics, Master (3./4.);

Teilnahmevoraussetzungen: „Hochdurchsatzdatenanalyse Teil 1“ (M-BS2-S4A)

Qualifikationsziele:
Die Studierenden
- können fortgeschritene bioinformatische Programmierkenntnisse zur Analyse von Hochdurchsatzdaten sicher anwenden;
- sind in der Lage, aus verschiedenen Hochdurchsatztechnologien stammende komplexe Datensätze integrativ zu analysieren;
- sind in der Lage, aus Hochdurchsatztechnologien stammende Daten systembiologisch zu interpretieren;
- können komplexe Hochdurchsatzdaten in angemessenen graphischen Repräsentationen darstellen;
- können aus Hochdurchsatzdaten experimentell testbare Hypothesen ableiten;
- können effektiv bioinformatische Analysen gegenüber multidisziplinären Arbeitsgruppen kommunizieren.

Inhalte:
- Praxisorientierte Vertiefung der bioinformatischen Programmierkenntnisse durch die beispielhafte Auswertung von Hochdurchsatzdaten
- Analyse komplexer Datensätze aus Hochdurchsatzexperimenten
- Integration von systembiologisch relevanten Hochdurchsatzdaten aus verschiedensten (öffentlichen) Quellen
- Vorstellung der ermittelten Ergebnisse
- Vorstellung aktueller Literatur

Veranstaltung:	Präsenzstunden	Vor- und Nachbereitung
Vorlesung	20	20
Übung	20	20
Gruppenarbeit	20	80
Summe:	180	

Prüfungsvorleistungen: siehe §°7 SpezO .MSc. Bioinformatik / Systembiologie

Modulprüfung:
- Prüfung: Präsentation eines Softwareprojekts (20 min) und Protokoll (5-10 Seiten, Code und Dokumentation des Softwareprojekts
- Bildung der Modulnote: Präsentation (20 %), Protokoll (80 %)
- 1. Wiederholungsprüfung: mündliche Prüfung (30 – 45 min) oder Bericht (10 Seiten)
- 2. Wiederholungsprüfung: Siehe § 10 (4)

Unterrichts- und Prüfungssprache: Deutsch und/oder Englisch, wird vor Veranstaltungsbeginn verbindlich festgelegt und bekanntgegeben.