emPLANT
master to sucseed

COURSE CATALOGUE

UH SEMESTER 3

emPLANT COURSE CATALOGUE

ERASMUS MUNDUS MASTER PROGRAMME IN PLANT BREEDING

Contents

Joint Courses

JOINT COURSES	Description, contents, learning outcomes	Prerequisites	Implementation:	ECTS
Pilot case	Semester 1 and 2: UniLaSalle, SLU Semester 3: UH, UPV, EgeU The pilot case is a case study to apply the project management tools to a breeding program. First students by group have to choose a species to be ameliorated. Then, find a character or several ones as goal for the breeding strategy. The students need to check the market potential for this new variety and verify that farmers will want to cultivate it. Secondly, students will define the potential market for their product (seeds), but also the market for the new variety (consumers). Thirdly, they need to create a structure to breed the new variety, and define the role of each student of the group in this structure (company, association...).	No prerequisites	The introduction to the Pilot Case will take place during the Joint Integration Week where the groups will be formed based on the specialty chosen by the students for Y2. During the first year the students will work in groups with their tutors and via telephone/video conference/email if group members are not located at the same site (LAS/SLU). During S3 the Pilot Case will be finalized with the tutors at the host university and by telephone/video conference/email among the group members. Two juries will be organized. The first jury at the end of S1 will evaluate the content and the form of the work and especially the project management content. At the end of S2 a written report will be evaluated. At the end of S3 a jury composed of the local tutors, the Coordinators for Y1 and an expert in Project Management will judge the defense of the Pilot Case. The students of S1 and S3 will be able to attend their respective presentations. The juries of S1 and S3 will be carried out on the same day for logistic reasons.	**S1: 3** **S2: 3** **S3: 2**
Bioinformatics	Biological databases, gene analyses, web-based analytical tools, Unix OS, functional genomics, molecular evolution, RNAseq expression analysis, annotation of new genomes	No prerequisites	This course will be offered via videoconference and tutorials and accompanied by tutors at the host universities. The class will be validated by a computer-based exam.	**S3: 2**

Big Data	Using big data in Plant breeding, Machine Learning Methods (10h lecture, 12h tutorials) Algorithmic/Software Development Clustering Random Forests K-Nearest Neighbors Method/ Kernel Methods Sparse Methods for high dimensional data Databases (Big data) Management (4h lecture 4h tutorials) Distributed file systems, Hadoop Parallel, distributed, massive data processing with Map Reduce NoSQL/NewSQL databases	Basic Statistics and Probability, Statistical Inference, Regression Models Database using Access	This course will be offered via videoconference and tutorials and accompanied by tutors at the host universities. The class will be validated by a computer-based exam.	**S3: 2**

Semester 3 UH

SEMESTER 3 UH	Learning outcomes	Contents	Prerequisites	ECTS
Personal Study Plan (PSP)	After completing the study unit, the student has devised an individual plan for the Master's degree studies to be completed and a timetable for their completion	Student prepares a personal study plan where she/he reflects her/his strengths and areas of development, decides aims for her/his studies, and prepares a detailed study plan. A personal study plan can include elements related to career development. Study plan will be prepared independently after which it will be approved by the professor/student adviser on the study track		**0**
Breeding of crop plants (S3 in 2019 and in 2021)	The student will become acquainted with the practical breeding of agricultural and horticultural crop plants	Introduction to the practical breeding of agricultural and horticultural plants. Lectures by expert breeders. Presentations by students.	Basic knowledge in plant breeding or related disciplines.	**5**
Forest Tree Breeding (S3 in 2020)	The student will become acquainted with modern theories and practices in forest tree breeding	Recent results and theories concerning the physiological basis and restrictions of yield production implications for breeding. Patterns of adaptation and variation in forest trees with a special reference to northern environments	Basic course in statistics	**5**
Scientific Writing and Seminar	The student is able to reason using the scientific style of writing through the combination of analysis of a published paper and writing a preliminary version of part of the Master's thesis in an appropriate scientific style. The student can apply the principles of the structure of the scientific paper in his/her own Master's thesis. The student can give an oral presentation in a scientific style on the results she/he has obtained	Analysis of a published paper as a group work. Presenting results in tables, graphs and illustrations. Stepwise preparation of parts of a scientific paper (Introduction, Materials & Methods, Results, Discussion), with feedback from peers. Students will use part of their own MSc thesis data wherever possible, and a sample dataset will be provided for those who do not have their own data. MSc thesis seminars, preparation of an own seminar presentation as well as a task as an opponent in an MSc thesis seminar are included		**5**

Literature	After the course, the student is able to analyze and understand a defined topic of plant and forest breeding and biotechnology. She/he can apply theoretical knowledge to solve problems in the defined subject area	The student will choose a book from the field of plant and forest breeding and biotechnology, in consultation with the responsible teacher. The student will read the book independently, participate meetings and introduce the materials to other participants, seek further information when needed, prepare a learning diary describing the learning process and/or write a short summary of the contents of the book		**4**
Orientation Week	The aim of the orientation course is to familiarize students to the University of Helsinki, the Faculty of Agriculture and Forestry and the student's own MSc programme. After the orientation course the student will have knowledge of the necessary things to begin the studies in the MSc programme. Student is also acquainted with the study environment, the campus, lecture rooms and other important facilities within programme / campus. In addition the student becomes a part of the Faculty community, especially by getting to know fellow students and staff members of their MSc programme	The orientation course is meant for all new students of the Faculty. The course includes info sessions, tutoring sessions and program organized by the MSc programmes		**0**
Plants in Changing World	After completing the course the student • can identify her/his areas of interest in plant science that helps her/him in the selection of the most appropriate courses and course modules for the degree, and also a tentative topic for Master's thesis • gets an overview of plant science from molecules and cells to ecosystems and future plant and forest production • will appreciate the role and importance of basic research for practical applications in the various uses and production of plants • acquires a general view of the research topics and research groups within plant science, that form the Viikki Plant Science Centre at the campus, with a view to Master's thesis	This is a "showcase" course where plant science study modules offered in three Master's Programmes, as well as the respective research activities and groups at the campus, will be introduced. The course encompasses four main themes: • Plant diversity • Plant adaptation • Plant breeding and biotechnology • Changing use and production of plants		**5**

Plant Biotechnology and Molecular Biology	On this course students will acquire the following knowledge and skills • Understand how information encoded in DNA is used to shape the entire life of a plant. • Explain the various regulatory mechanisms in plant gene expression using examples from plant development, hormone or stress signaling. • Recognize the essential role of “next-gen” sequencing in modern plant molecular biology and biotechnology. • Be familiar with various methods to make genetically modified or genome edited plants. • Be able to discuss advantages and disadvantages on the use of genetically modified plants, and to support their opinions based on current legislation and risk assessment. • Produce an English text with arguments for or against the use of genetically modified plants. • Get a working knowledge of various online databases with plant genome, gene expression or other data, and be able to use this information to characterize a new unknown DNA sequence	Lectures will familiarize students with • structures and function of plant genomes • the Central Dogma in molecular biology • regulation of gene expression • molecular biology of *Agrobacterium*-mediated gene transfer • molecular basis of vegetative-reproductive transitions and flower development • molecular biology of hormone and signal transduction in plants • molecular basis of abiotic and biotic stress responses in plants • forest biotechnology • plant secondary metabolism • basics of plant gene isolation methods and gene transfer methods to plants • introduction to various methods in plant molecular biology including genome editing techniques (Crispr-Cas) • basics for legislation and risk assessment of plant biotechnology • introduction to applications and ethics of plant biotechnology • advantages and disadvantages of the use of genetically modified plants • introduction to plant bioinformatics related databases		**5**
Advanced Training in a Research Group	The student is able to work independently in a research group or other working group and knows the principles of scientific reporting of research results	Full-time working in a research group, organization or private company for 1 month. Student has her/his own project where she/he learns the skills required in research or other working group under a guidance of a supervisor. She/he will become familiar with the research question or relevant questions related to her/his tasks by studying the related scientific literature and discussing about them with the supervisor. At the end of working period she/he will write a short report which will be submitted to supervisor together with worksheet		**5**

BLUP and Variance Components (S3 in 2019 and in 2021)	The student would understand the concept of breeding value, utilization of information on relatives and of genomic information in determining similarity among individuals, application of BLUP evaluation modelling for quantitative traits, estimation of genetic variation in important production and longevity traits and students would be capable to perform practical applications with R software	• Variances and covariances of random variables, statistical model, inverse of genetic relationship matrix, genomic relationship matrix, estimation of model parameters, mixed model equations, BLUP applications and genomic breeding value. • Simulation of data, characteristics of (co)variance component estimation methods: ANOVA, Maximum Likelihood, Restricted Maximum Likelihood, Bayesian procedures. • Utilization of genomic information in constructing covariance structures • Many topics are practiced with homework involving R program packages		**5**
Wood Structure, Growth and Differentiation	After the successful completion of the course the student knows • the structure of soft- and hardwoods and growth • many exceptional features of wood • the structure and biochemistry of the cell wall and its biosynthesis • the biotechnological possibilities for the use of woody material and its chemical components • the basic principles in the identification of wood species by their microscopical xylem structure • the making of cryomicrotome sections of woody material and their staining • the manufacture of permanent microscope slide	The central material of the course is the structure of soft- and hardwoods, growth and many exceptional features of wood, and the structure and biochemistry of the cell wall and its biosynthesis. The practical part consists of microscopical analysis of Finnish soft- and hardwoods and their differences as well as sectioning and staining of wood sections to produce permanent microscope slides. The course also includes a demonstration on wood strength properties. Students test bending and compression strength of two tree species and write a test report		**5**

Basic biotechnology applications in forestry	• Appreciation of diverse areas of biotechnology process that are relevant in Forestry • Understand the historical background on applied and modern biotechnology • Develop awareness on how biotechnology can impact on forestry practices in the coming decades • Identify key topic areas that might require immediate or long term intervention with biotechnology tools	• Biotechnology: history, processes and potentials in Forestry: An overview • Forest trees and their microbial partners: The potentials (Phytoremediation, biopulping etc) • Tree Health problems-an overview • Application of DNA/molecular techniques in fungal biodiversity analyses • Endophytes in biotechnology • Biological control: Principles and applications in tree health protection • Forest tree breeding • Fungal Biotechnology: secondary metabolites, lignocellulose bioconversion, first and second generation biofuel • Biodegradation and biodeterioration technology • Tree biotechnology-GM trees (concept, principles and applications) • Ethical and environmental implications of GM-trees: Impact of GM trees on Biodiversity, insect resistance, disease resistance, tolerance to environmental stress, sterility of GM trees, environmental release, regulatory framework, environmental and human health benefit of GM trees, Risk aspects of GM trees to human health and biodiversity • Excursions: to Biotechnology company, forest tree breeding station forest tree nursery etc	Basic background knowledge	**5**
Finnish course	The aim is to introduce students not only to the basic structures of Finnish, but also to the Finnish way of life. Simple everyday conversation is practised.	The topics range from introducing and telling about oneself to greetings, family, food, shopping, weather and telling the time. The topics also include daily activities, living, transport and the immediate surroundings.		*****

*No ECTS but an official language certificate