COURSE CATALOGUE

UMIL SEMESTER 3

emPLANT+ COURSE CATALOGUE

ERASMUS MUNDUS MASTER PROGRAMME IN PLANT BREEDING

Contents

Joint Courses

JOINT COURSES	Description, contents, learning outcomes	Implementation:
Pilot case	The pilot case is a case study to apply the project management tools to a breeding program. First students by group o choose a species to be ameliorated. Then, find a character or several as goal for the breeding strategy. After, they check that there is a potential market for this new variety and verify that farmers will want to cultivate it and consumers too (1-week work) To be accomplished during all the first year. Secondly students are going to define the potential market for their product (seeds), but also the market for the new variety (consumers). Thirdly they need to create a structure who is going to breed the new variety, and define the role of each student on the group in this structure (company, association...)	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. 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 and a second presentation more focused on the breeding schema 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 juries of S1 and S3 will be carried out the same day for logistic reasons.
Bio informatics	Biological databases; gene analyses, web-based analytical tools, Unix OS, functional genomics, molecular evolution, RNAseq expression analysis, annotation of new genomes.	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.
Big Data	Clustering, Random Forests, K-Nearest Neighbors Method/ Kernel Methods, Sparse Methods for high dimensional data. Databases (Big data) Management Distributed file systems, Hadoop, Parallel, distributed, massive data processing with Map Reduce NoSQL/NewSQL databases	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.

Semester 3 UMIL

SEMESTER 3 UMIL (30 credits)	Objectives	ECTS
Molecular methods for plant breeding	The course provides in-depth elements of plant breeding, referring to the use of techniques of biometrics, molecular biology, genomics, functional genomics and genetic engineering. The first part of the course provides a review of the concepts of Mendelian genetics aimed to understand the application of molecular markers in mapping studies of genomes and identification and cloning of the chromosomal regions responsible for simple and quantitative characters (QTL). The theme of molecular markers is addressed with their applications to both mapping and fingerprinting of genomes. The concept of marker-assisted selection (MAS) is developed accordingly. The second part deals with the theme of next-generation sequencing (NGS) and large-scale analysis of genomes with applications like Genotyping by Sequencing (GBS), Genome-Wide Association Studies (GWAS) and Genomic Selection (GS). The third part of the course is devoted to the study of gene expression, starting with the simplest cases up to large-scale applications, which are addressed by the most recent technologies (i.e. RNA-seq and variations). Bioinformatic methods of data analysis and access to major biological databases with simulations in the classroom are also addressed. The fourth part of the course will outline the production and use of transgenic plants for applications aimed at the improvement of agronomic and technological traits. Important and integral elements of the course consist of exercises in the classroom and in the laboratory that allow the student to practice more in depth and better understand the concepts exposed in the lectures.	6
Plant molecular biology	Objective of the course is to provide students with knowledge of molecular biology concepts and experimental approaches to understand gene function in plants, also through the analysis of case studies in crops The student will become familiar with the approaches used to investigate the fundamental link between gene structure, function and phenotype. Competences will also include the analysis of gene sequence and expression as well as allelic variations.	6
Crop modeling	**Training objectives** · Teach the basic principles of agronomic process simulation, and the methods to adapt agronomic models at different crops, soils and climates. · Favour learning of a process-based quantitative approach to analyze the interactions crop x environment x management. · Provide examples of model calibration, validation and sensitivity analysis using case studies. **Expected learning outcomes** Know and understand: · principles of cropping system models; · ways to simulate crop development and growth; · ways to simulate crop response to some abiotic and biotic stresses; · model calibration, validation and sensitivity analysis. Be able to: · implement simple crop development and growth models;	6

	· apply these models at different climatic conditions (present and future); · carry out calibration, validation and sensitivity analysis.	
Basic statistics and experimental design	Overview on descriptive statistics, sampling distribution and statistical test: Basic of descriptive statistics: central tendency and dispersion indices. Characteristics of samples and populations. Main probability distribution. Usage of the normal distribution and of the standardized normal distribution. Estimation of population parameters from a sample. Bias, consistency and efficiency of an estimator. The structure of a statistical test: two-tail and one tail-test, the null hypothesis, the significance level, power of a test, type I, II and III errors. Practical use of statistical software to do descriptive data analysis and ANOVA (2- 3 way). Experimental planning and field management of the experiments. Uncontrolled sources of error and the determination of the number of replications. Randomized blocks, Latin squares, split plot and strip plot experimental arrangement. Practical implementing in a field of experimental arrangement. Practical use of statistical software to analyze field experiments carried out under different experimental schemes	6
Plant Breeding	Essentials of Genetics: Quantitative genetics and Population genetics. Chromosome and gene mutations. Plant propagations: allogamy, autogamy and vegetative propagation. Genetic constitution of the main crops: natural populations, ecotypes, synthetic populations, clones, inbreed lines, hybrids. Essential of genetics improvement in plant breeding: recurrent selection, inbred line extraction, backcrossing, hybrid varieties and mutagenesis. The "green revolution" and its genetic basis. New tools: marker assisted selection (MAS) and genetically modified plants (GM crops): resistance to pests and herbicides and other examples. Next Generation Sequencing and Genome editing.	6
Development of crop ideotypes	Objective of the course is to provide students with knowledge of multidisciplinary approaches to design and breed new crop ideotypes to improve quantity, quality, efficiency and sustainability of agricultural production for different end-uses. Integrating genetics, genomics and modeling, the course is centered on ideotype breeding with special focus on cereals and other cultivated plants as case studies.	6
Italian as a foreign language	Italian courses will cover the grammar rules, reading, and comprehension. The programme will be adjusted according to the level attained at the entry-level test (placement test). Students will attend one of the required courses. A1 from C1 60-hour courses are held each semester. Students who attend at least the 66% of in-person learning can take the end of course test and receive a language certificate and a certificate of attendance. Students from International Medical School have access to 80-hour annual courses to attain A1/A2, B1 and B2 levels.	Certificate