General information	
Academic subject	**Plant breeding (Module of Plant Breeding of Agricultural crops)**
Degree course	**Master Course in Plant Medicine (LM69)**
Academic Year	*Second*
European Credit Transfer and Accumulation System (ECTS)	6
Language	*Italian*
Academic calendar (starting and ending date)	*First semester*
Attendance	

Professor/ Lecturer	
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Virtual headquarters	
Tutoring (time and day)	To be agreed with the teacher via email and telephone

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Syllabus	
Learning Objectives	*The objective of the "Plant Breeding" subject is to transfer knowledge and tools to the student for the assessment of genetic variability* *At the end of the course, students will be able to:* ● *To deep knowledge on the availability, acquisition and exploitation of natural and induced genetic variation (plant genetic resources);* ● *Understand reproductive and genetic mechanisms underlying the evolution of crops, genetic structure of autogamous, allogamous and vegetatively propagated species, acquire knowledge on population and quantitative genetics in order to effectively carry out selection plans;* ● *To use the main plant breeding methods for varietal constitution and seed production;* • *Knowing appropriate molecular methodologies for conducting assisted selection programs.*
Course prerequisites	
Contents	**PLANT BREEDING AND USE OF GENETIC VARIATION** **Introduction.** Definitions and aims of plant breeding. Introduction and domestication of cultivated species. The ideotype in relation to natural environments and markets. **Reproductive systems in cultivated species.** Some morpho-physiological and genetic mechanisms related to reproductive system. Self-incompatibility and male sterility. Relationships between reproductive systems and plant breeding methods. Assessment of cross-pollination rate. **The plant genetic resources**. Origin and evolution of plant genetic resources. The centres of plant genetic diversity. Safeguard, collecting and conservation of germplasm. Entry definition. **POPULATION GENETICS** **Genetic systems and population structure of autogamous species**. Inbreeding e outbreeding. Selfing and selection. Johanssen's experiments. Sources of genetic variation in self-pollinated species. **Genetic systems and population structure of allogamous species**. Sources of

	genetic variation in cross-pollinated species. Hardy-Weinberg law. Factors of gene frequency change. Assessment of the inbreeding coefficient. Effect of inbreeding on Hardy-Weinberg equilibrium and quantitative traits. Inbreeding depression and heterosis. **Genetic systems and population structure of vegetatively propagated species**. Sources of genetic variation and germplasm. The definition of clone. **QUANTITATIVE GENETICS** **Genetic analysis for quantitative traits.** Definition of qualitative and quantitative traits. Polygenic theory. Phenotypic and genotypic values. Additivity, dominance and interallelic intractions in the quantitative inheritance. Broad and narrow heritability. Some examples of cross designs. **The selection**. Selection for qualitative and quantitative traits. The differential of selection and the genetic gain. Experiment of selection. Marker assisted selection. **Plant breeding for self-pollinated species.** The mass selection and pure line methods. Pedigree, mass-pedigree, bulk-population and single-seed-descent methods. Backcross method and doubled haploids. Examples of self-pollinated varieties. **Plant breeding for cross-pollinated species.** The progeny test. General and specific combining ability. Set-up of inbred lines. Mass selection. Half and full-sib selection. Reciprocal recurrent selection method. Backcross. Examples of cross-pollinated varieties. Landraces. Male sterility in hybrid varieties setting-up. Hybrid and synthetic varieties. **Plant breeding for vegetative propagated species**. Self-and out-crossing selection. Clonal selection. Methods to increase genetic variation. Early selection methods. Mono and poly-clonal varieties. **SOURCES OF VARIATION AND THEIR APPLICATION IN PLANT BREEDING** **Definitions and examples.** Interspecific and inter-generic hybridization. The polyploidy. The experimental mutagenesis. *In vitro* culture. The bio-engineering tools. **THE REGULATIONS FOR THE SET-UP OF NEW VARIETIES** **General rules for certificate seed production.** Set-up and registration of self- and cross-pollinated crops in national and U.E. lists. Plant breeder's rights. Seed trading.
Books and bibliography	• SCARASCIA MUGNOZZA G.T. (Coord.), 1988. Miglioramento genetico vegetale, Patron Editore, Bologna. • LORENZETTI F., M. FALCINELLI, F. VERONESI, 1994. Miglioramento genetico delle piante agrarie. Edagricole, Bologna. • LORENZETTI F., S. CECCARELLI, F. VERONESI, 1996. Genetica Agraria. Patron Editore, Bologna. • BARCACCIA G., FALCINELLI M., 2005. Genetica e genomica. Vol. II: "Miglioramento genetico". Liguori Editore, Napoli. • Notes of the lectures distributed during the course. • Solved exercises and overheads available in the DiBCA library
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
54	*40*	*14*	*96*
ECTS			
6	*5*	*1*	*6*

Teaching strategy	
	Lectures will be presented through PC assisted tools (Powerpoint, Adobe Acrobat, etc.), slide projector, overheads. Various materials might be shown to elucidate theoretical aspects ("*in vitro*" and "*in vivo*" specimens, tools, etc.)
Expected learning outcomes	
Knowledge and understanding on:	• *Knowledge and understanding* ○ Teaching will provide knowledge on: 1) reproduction systems of plant; 2) genetic structures of autogamous, allogamous and vegetative propagation crops; 3) plant breeding methods; population and quantitative genetics.
Applying knowledge and understanding on:	• Teaching allows the student to apply traditional and innovative techniques for the safeguard of genetic resources and their use in plant breeding
Soft skills	*Making informed judgments and choices* • The student will be able to speculate the mechanism of hereditability and to set up plant breeding plans. *Communicating knowledge and understanding* • The student will spur communications by means of interaction with teacher and of oral and written exam *Capacities to continue learning* • It will be evaluate by means of discussions during the lectures among teacher and students.

Assessment and feedback	
Methods of assessment	*For students enrolled in the course year in which the teaching is done there will be an intermediate test. This test is done by carrying out an oral exam The final exam takes place on the remaining parts of the program not included in the intermediate test, and it lasts for one year. For students who do not support the intermediate test, the exam consists of an oral exam on the topics covered both during lectures and lab, field and greenhouse training.*
Evaluation criteria	• *Knowledge and understanding* ○ The student have to be able to reach a sufficient knowledge on: 1) reproduction systems of plant; 2) genetic structures of autogamous, allogamous and vegetative propagation crops; 3) plant breeding methods; quantitative genetics. • *Applying knowledge and understanding* ○ The student have to be able to apply traditional and innovative techniques for the safeguard of genetic resources and their use in plant breeding • *Making informed judgements and choices* ○ The student have to be able to speculate the mechanism of hereditability and to set up plant breeding plans.

	• *Communication skills* ○ ability to organize the acquired knowledge in form of didactic presentation and to articulate it for didactic purposes • *Communicating knowledge and understanding* ○ The student have to be able to explain topics acquired during classes.
Criteria for assessment and attribution of the final mark	*The final examination mark will be in thirtieth.*
Additional information	