General Information	
Academic subject	Sustainable management of agricultural systems – The continuum soil-plant-atmosphere and soil and crop monitoring
Degree course	Sustainable management of the Mediterranean countryside
Curriculum	
ECTS credits	6 ECTs = 4 ECTs Lectures [L]+ 2 ECTs Lab & field cl. [L&Fcs]
Compulsory attendance	No
Language	Italian

Subject teacher	Name Surname	Mail address	SSD
	Anna Maria Stellacci	annamaria.stellacci@uniba.it	AGR/02

ECTS credits details	Area	SSD	Credits
Basic teaching activities	Disciplines of Production	AGR/02	6

Class schedule	
Period	First semester
Year	Second year
Type of class	Lecture

Time management	
Hours	150
In-class study hours	60
Out-of-class study hours	90

Academic calendar	
Class begins	2th October 2017
Class ends	26th January 2018

Syllabus	
Prerequisites/requirements	
Expected learning outcomes (according to Dublin Descriptors)	*Knowledge and understanding* o Knowledge of the relationships between plant and environment considering climatic, physiologic and soil data; o Knowledge on the use and computation of decision making tools for evaluating the effect of different agronomic management techniques; o Knowledge on the main techniques for crop and soil monitoring. *Applying knowledge and understanding* o Applying knowledge for the sustainable management of the agronomic techniques using information on the soil-plant atmosphere relationship, on the techniques and tools for monitoring the soil and crop and on decision making tools. *Making informed judgements and choices* o Ability to interpret the effects of different soil managements and agronomic techniques on plant response; ability to evaluate the efficacy of different

	innovative strategies for the sustainable management of the agronomic techniques; ability to choose the optimal cropping patterns. *Communicating knowledge and understanding* o Ability in presenting and discussing complex issues on the relationships in the continuum soil-plant-atmosphere, on the soil quality monitoring, on the technologies and methodologies for soil and crop monitoring. *Capacities to continue learning* o Capacities to further deepen the techniques, the instruments and the methods of advanced analysis for soil and plant monitoring.
Contents	• Introduction: environmental sustainability and sustainable management of cropping systems • Soil quality and multivariate indices of soil quality: definition; chemical, physical and biological indicators; computation • Soil physical quality. The soil as a polyphasic system; methods for assessing the relationships among soil components and phases. • Soil hydrostatics. Total soil water potential and its components (capillary, matric, gravity, pressure, osmotic potentials); total soil water potential and crop hydric supply; methods to measure the soil water potential. The water retention curve. • Soil hydrodynamics. Generality on fluid dynamics; the laminar flow under saturated and unsaturated soil; water conductivity in saturated and unsaturated soil. Flow under unsaturated conditions. Permanent unidimensional flow in unswelling soils; generality on various flow in unsaturated soils; soil water infiltration. • Solute movement in the soil. Diffusion movement; Fick law, convection, hydrodynamic dispersion; absorption; transport with simultaneous solute production and disappearance • The gaseous phase in the soil. Agronomic role of the gaseous phase in the soil; causes and types of gas movement in the soil. • The thermic properties of the soil. Agronomic role of temperature and heat; processes of heat propagation/transfer in the soil; heat transfer by conduction; effect of soil water content on thermic conductivity, thermic capacity and thermic diffusivity. • Water movement in the continuum soil-plant-atmosphere. Water transport in plant. Meteorological variables. Solar radiation; temperature; relative air humidity; rainfall; wind. evaporation and evapotranspiration. • Multivariate indices of soil quality. Definition; main steps for their computation: definition of a minimum dataset of indicators; indicator normalization; computation of

	weighted additive indices. Methodologies of multivariate data analysis. • Soil and crop status monitoring. Proximal and remote sensing; proximal sensors and methods for soil and crop properties assessment: definition, types, uses. Continuous monitoring of soil and crop properties. • Proximal sensors based on spectroradiometry; Vis-NIR reflectance spectrometers; methods of data analysis through hyperspectral sensors. Classification of radiometric sensors and their applications • Proximal geophysical sensors. Electromagnetic induction (EM) sensors; mobile georesistivimeter; georadar. • Proximal sensors for crop status monitoring. Vis-NIR spectrometers and fluorimeters. • Use of information deriving from proximal sensors in agronomic techniques management (irrigation, fertilization, weed control). Determination of homogeneous management zones.
Course program	
Bibliography	Notes of the lectures and teaching material distributed during the course. • Giardini L., 2002. Agronomia generale e ambientale. Patron editore • Cavazza L., Fisica del terreno agrario. • AA.VV, 2015. Agricoltura di precisione. Metodi e tecnologie per migliorare l'efficienza e la sostenibilità dei sistemi colturali. Curato da R. Casa. Edagricole Additional readings Gomez K.A., Gomez A.A., 1984. Statistical procedures in agricultural research. New York, Chichester, etc.: Wiley, 2nd edition France J., Thornley J.H.M., 1984 - Mathematical Models in agriculture. Butterworths, London. Further material will be provided on request by the teacher.
Notes	
Teaching methods	Oral presentation supported by Power Point presentations, by the usage of blackboard and by documents prepared by the teacher.
Assessment methods (indicate at least the type written, oral, other)	The final exam consists of an oral test with questions related to the lectures and laboratory classes, whereas the intermediary exam consists of a written test such as reported in the Didactic Regulation in Sustainable management of the Mediterranean countryside and in the syllabus (annex A). The evaluation of the student is based on criteria previously fixed such as reported in the Annex A of the Didactic Regulation of the Master Course in Sustainable management of the Mediterranean countryside and is expressed in thirty.
Evaluation criteria	*Knowledge and understanding* o The student has acquired knowledge of the relationships between plant and environment considering climatic, physiologic and soil data; o The student has acquired knowledge on the use and computation of decision making tools for evaluating

	the effect of different agronomic management techniques; o The student has acquired knowledge on the main techniques for crop and soil monitoring. *Applying knowledge and understanding* o The student will be able to apply knowledge for the sustainable management of the agronomic techniques using information on the soil-plant atmosphere relationship, on the techniques and tools for monitoring the soil and crop and on decision tools *Making informed judgements and choices* o The student will be able to interpret the effects of different soil managements and agronomic techniques on plant response; ability to evaluate the efficacy of different innovative strategies for the sustainable management of the agronomic techniques. *Communicating knowledge and understanding* o The student will be able to present and discuss critical issues on the relationships in the continuum soil-plant-atmosphere, on the soil quality monitoring, on the technologies and methodologies for soil and crop monitoring. *Capacities to continue learning* o The student will be able to further deepen the study and knowledge on the techniques, the instruments and the methods of advanced data analysis for soil and plant monitoring.
Further information	