Stampare su carta intestata del CdS

General information	
Academic subject	***Sustainable management of cropping systems*** ***(module of the integrated course (C.I.) Sustainable management of agricultural systems)***
Degree course	Master degree in Scienze Agro-Ambientali e Territoriali
Academic Year	*2021-2022*
European Credit Transfer and Accumulation System (ECTS)	6
Language	*Italian (English will be used when required for foreign students and into didactic material)*
Academic calendar (starting and ending date)	*I semester (September 27th 2021 – January 21st 2022)*
Attendance	*No*

Professor/ Lecturer	
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Virtual headquarters	*TEAMS platform: annamaria.stellacci@uniba.it*
Tutoring (time and day)	Tutoring will take place during official visiting days and hours (Monday-Friday; 8.30-13.30), according to appointments to be arranged in advance by e-mail. Tutoring could also take place on e-learning platforms (Microsoft Teams).

Syllabus	
Learning Objectives	Provide knowledge and understanding on: o scientific methods for monitoring and analysis of agricultural and environmental systems; o sustainable management and conservation of natural resources in agriculture.
Course prerequisites	Prerequisites for the access to the Master degree.
Contents	• Introduction: environmental sustainability and sustainable management of cropping systems. Precision agriculture, definitions and goals; sensors for soil and crop monitoring (Vis-NIR sensors; geophysical sensors). • Agro-environmental indicators as tools for measuring the sustainability of agronomic techniques and cropping systems. Models for the representation of the environmental components; the DPSIR framework applied to the soil compartment. • Soil quality and multivariate indices of soil quality (SQIs). Definitions. • Main steps for computing SQIs: management goals and soil functions; minimum dataset of indicators (MDS); indicator normalization and scoring; computation of weighted additive indices. Brief overview of multivariate data analysis methodologies for variable/indicator selection. • Soil physical quality. The soil as a polyphasic system; indicators and indices for assessing the relationships among soil components and phases (ρ_{aps}, ρ_s, porosity, volumetric and gravimetric soil water content, air capacity, void ratio, moisture ratio, saturation rate, soil compaction); laboratory and field methods for assessing ρ_{aps}. Applications for soil and crop management.

	• Soil hydrostatics. Soil water potential: concepts and measurement. Components of the total soil water potential; total soil water potential and crop hydric supply. The water retention curve. Methods for measuring the soil water potential and estimating the soil water retention curve. • Elements of soil hydrodynamics. Generality on fluid dynamics. The laminar flow under saturated soil; the Darcy law. Water conductivity in saturated and unsaturated soil. Soil water infiltration. The soil water conductivity function ($k(\psi_{pm})$) under different soil types and soil management. • Capacitive and hydrodinamic indicators for assessing soil quality. • 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. Elements of solute movement in the soil. • Water movement in the continuum soil - plant -atmosphere. Water transport in plant. Meteorological variables. • Applications of theoretical aspects: computation of the nutrient balance for optimizing fertilizer input; computation of total and readily avalilable water (TAW and RAW) for irrigation scheduling; soil water retention curve and agro-environmental applications; innovative and accurate methods for measuring soil hydraulic functions –BEST method; computation of soil quality indices. • Seminars and applications • Application of proximal sensing methods for precision soil and crop management and sustainable use of water and nitrogen resources. • Use of plant-based indicators for monitoring soil and crop status and sustainable management of agronomic techniques.
Books and bibliography	Notes of the lectures and teaching material distributed during the course. • Cavazza L., 1981. Fisica del terreno agrario. UTET, Torino, 1981. • Cavazza L. e Patruno A., 2005. Terreno agrario. Il comportamento fisico. Ed. REDA (2005). • Giardini L., 2002. Agronomia generale e ambientale. Patron editore • 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 materials	Additional readings • Scientific papers provided by the teacher. • Papers published by the scientific societies (SIA, AISSA) on studied topics (sustainable intensification, conservation agriculture, precision agriculture, agroecological transition). Further material will be provided by the teacher on request.

Work schedule			
Total	Lectures	Hands-on-classes (on-class exercises, seminars by experts in the studied disciplines, case-study analysis, working groups)	Out-of-class study hours/ Self-study hours
Hours			
60	*32*	*28*	*90*
ECTS			
6	*4*	*2*	
Teaching strategy	Learning activities will consist in theoretical lectures and applied activities including		

	exercises and applications for optimizing soil and crop management, study case analysis, seminars and lessons from experts in the studied disciplines. Oral lessons will be supported by Power Point presentations, the use of the blackboard and by documents prepared by the teacher. E-learning through public platforms (e.g. Teams) can be used, on demand.
Expected learning outcomes	
Knowledge and understanding on:	• 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 on:	• 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.
Soft skills	• *Making informed judgments 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* 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. Expected learning outcomes, as knowledge and ability, are reported in the annex A of the Didactic Regulation of the Master course (expressed by European Descriptors).

Assessment and feedback	
Methods of assessment	The final exam consists of an oral test with questions related to the lectures, exercises and laboratory classes. An intermediary written exam will be also performed, including exercises on theoretical and applied issues studied. The evaluation of the student is based on criteria previously fixed such as those reported in the Annex A of the Didactic Regulation of the Master Course and is expressed in thirtieths.
Evaluation criteria	○ *Knowledge and understanding* ○ 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* ○ 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.
Criteria for assessment and attribution of the final mark	*The final score is within 18/30 to 30/30. The exam is considered passed if a final score of at least 18/30 is reached.*
Additional information	