General information	
Academic subject	***Pesticide application equipment (Module of I.C. Applied engineering)***
Degree course	*Plant Medicine (LM69)*
Academic Year	*2*
European Credit Transfer and Accumulation System (ECTS)	3
Language	*Italian*
Academic calendar (starting and ending date)	*First semester (27/09/2021 - 21/01/2022)*
Attendance	*optional*

Professor/ Lecturer	
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Tutoring (time and day)	Every Friday 10.30 – 12.30 according to an established appointment requested by phone or e-mail. Tutoring could be also on e-learning platforms.

Syllabus	
Learning Objectives	*The course aims to provide in-depth knowledge about: machinery for the distribution of plant protection products in their various formulations; the requirements for a correct distribution of plant protection products; machinery for the distribution of products in liquid form and the related problems of the evaluation and management of droplets population; machinery for treatments on covered crops*
Course prerequisites	*Mathematics, Physics and Agricultural Mechanics and Mechanizations (propaedeutic).*
Contents	• *Management of spontaneous vegetation by physical tools. Mechanical weeding. devices for thermal treatment (flame weeding equipment). Thermal control of weeds by means of steam, water and hot air* • *Characteristics concerning plant protection products; technical information regarding doses, concentrations, volumes, deposits, residues, conditions for proper distribution and methods of use. Determination of the volumes to be delivery based on the canopy volume (TRV, Tree Row Volume). Determination of the volumes to be delivery based on the "leaves wall area" parameter. Classification of sprayer machinery based on delivered product status. Sprayer machinery for solid state pesticide: dusters. Equipment for spreading granular and micro-granular products. Evaluation of the uniformity pertinent to the longitudinal distribution. Determination of the flow rate to be distributed. Specific distributors for microgranules.* • *Qualitative aspects of the pesticide distribution in liquid form. Objectives of the atomizing of the liquid vein in a population made of more or less small droplets. Mathematical considerations. Operating parameters. VMD, NMD and other parameters to express the droplets size. Methods for measuring the droplets.* • *Techniques used for atomizing the liquid vein into droplets (by pressure on the liquid, pneumatic, by centrifugal action, by thermal action, by electrodynamic action).*

	• *Classification of spraying machinery (for tree crops and herbaceous crops). Technologies and functions of the sprayer machinery. Sprayer machines equipped with projected spray and carried spray.* • *Technologies, components, operations, adjustment systems and selection criteria sprayer machinery.* • *Sprayer machinery suitable for treatments on covered crops.* • *Techniques to avoid point pollution produced by pesticides. The "best management practices" (BMP) for the following processes: transport, storage, pre-distribution phase, distribution, post-distribution phase, management of wastewater and residual products. Biodepuration systems.* • *Techniques to avoid diffuse pollution produced by pesticides. Main contents of Directive 2009/127/EC. Directive 2009/128/EC. Concept of drift and related evaluations and measurements in open field and inside laboratory. Operative factors affecting the drift. Measures to protect the environment from drifting* • *Adjustment of the boom sprayers and atomizers.*
Books and bibliography	• *Lecture notes and course materials distributed in class* • *CIGR Handbook of Agricultural Engineering - Volume III - «Plant Production Engineering». Edited by CIGR—The International Commission of Agricultural Engineering, 1999* • *G.A. Matthews - « Pesticide Applications Methods » – 3° Edition -Edited by Blackwell Science Ltd, United Kingdom, 2000* • *P. Balsari, G. Airoldi - «Macchine per la distribuzione dei fitofarmaci e per il controllo delle malerbe nelle colture erbacee». SAVE, Milano, 1993* • *D. Savi - «Attrezzature per la difesa delle piante». Edizioni L'Informatore Agrario, Verona, 1996* • *Vieri M. «Le attrezzature impiegate nella irrorazione di prodotti fitosanitari». DIAF – University of Florence*
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
75	*16*	*14*	*45*
ECTS			
3	*2*	*1*	

Teaching strategy	
	The topics of the course will be treated with the help of Power Point presentations and samples of machinery and equipment. *All students will be able to receive a copy of the Power Point presentations used during lectures.*
Expected learning outcomes	
Knowledge and understanding on:	○ Knowledge of equipment for the application of the pesticides also related with new precision agricultural systems. ○ Knowledge of the main sprayer setup systems, with reference to recent European Directives on the sustainable use of pesticides. ○ Knowledge of innovative design of integrated crop protection ad management systems to improve the qualitative, quantitative and sanitary

	aspects of plant production.
Applying knowledge and understanding on:	○ Applying knowledge to recognize and manage machinery for pesticides application. ○ Applying knowledge to choose the equipment for pesticides application. ○ Applying knowledge to setup and identify operating parameters suitable for improving the efficiency of spraying machinery, with reference to recent European Directives on the sustainable use of pesticides. ○ Applying knowledge to identify the technologies and good practices of attenuation of drift phenomena. ○ Applying knowledge to use of integrated pesticides management techniques and plant protection to improve the qualitative, quantitative, and sanitary aspects of plant production.
Soft skills	• *Making informed judgments and choices* ○ Ability to analyze the different production systems and market environment, to plan actions and to manage interventions to improve the quality and efficiency of crop protection and any other related activity, including in terms of sustainability and eco-compatibility. ○ Ability to work autonomously in a team with technical experts and operators in the field of applied crop protection. • *Communicating knowledge and understanding* ○ Ability to expose and argue on complex issues of applied crop protection both in written and oral form. ○ Communication and reporting skills within a multidisciplinary working group and ability to judge technical, economic, human and ethical issues. ○ Ability to use, in written and oral form, at least one language of the European Union beyond Italian, preferably English • *Capacities to continue learning* ○ Ability to learn through the development of cognitive tools and logical elements related to the applied engineering industry for crop protection. ○ Ability to use the tools and new IT technologies that ensure a continuous updating of knowledge in the specific professional field and in the field of scientific research. Expected learning outcomes, as knowledge and ability, are reported in the annex A of the Didactic Regulation of the course Plant Medicine (expressed by European Descriptors)

Assessment and feedback	
Methods of assessment	*The exam consists of an oral test on the topics developed during the lectures hours as reported in the Didactic Regulations of the Master's Degree Course in Plant Medicine (DM270) and in the study plan (attachment A).* *The evaluation of the student's preparation will take place on the basis of pre-established criteria, as detailed in Annex A of the Didactic Regulations of the Master's Degree Course in Plant Medicine. A minimum of 4 questions will be asked, two of which on the components of spraying machinery, and two on the criteria for choosing and adjusting this type of machinery.*
Evaluation criteria	• *Knowledge and understanding* ○ The student will be able to recognize the equipment for the pesticides application. ○ The student will be able to operate with the main sprayer setup systems, with reference to recent European Directives on the sustainable use of

	pesticides. ○ The student will be able to design innovative integrated crop protection and management systems. • *Applying knowledge and understanding* ○ To know the main phases of regulation of machines for the application of plant protection products. ○ To know how to adjust and identify the main operating parameters of sprayers, with reference to recent European regulations on the sustainable use of plant protection products. ○ To know how to identify the technologies and good practices able to mitigate the drift phenomena. • *Autonomy of judgment* ○ To be able to choose and evaluate the most suitable machine according to the different situations of a production context. ○ To be able to choose the most suitable technical/ professional operators for interventions on machinery with skills in the sector of crop protection • *Communicating knowledge and understanding* ○ The student will be able to expose and argue on complex issues of applied crop protection both in written and oral form. ○ The student will be able to communicate within a multidisciplinary working group and reporting on technical, economic, human and ethical issues. • *Communication skills* ○ The student will be able to use, in written and oral form, at least one language of the European Union beyond Italian, preferably English. ○ The student will be able to organize the acquired knowledge in form of didactic presentation and to articulate it for didactic purposes • *Capacities to continue learning* ○ The student will be able to learn through the development of cognitive tools and logical elements related to the applied engineering industry for crop protection. ○ The student will be able to use the tools and new IT technologies that ensure a continuous updating of knowledge in the specific professional field and in the field of scientific research.
Criteria for assessment and attribution of the final mark	*The evaluation of the students' achievement will be expressed with a mark out of thirty. The exam is passed with a score of at least 18/30. In the case of maximum marks (30/30), honours can be attributed.*
Additional information	