

General information	
Academic subject	Environmental chemistry
Degree course	<i>Food Science and Technology (LM70)</i>
Academic Year	<i>First</i>
European Credit Transfer and Accumulation System (ECTS)	6 ECTS
Language	<i>Italian</i>
Academic calendar (starting and ending date)	<i>February 27st, 2023 – June 13th, 2023</i>
Attendance	<i>No Compulsory</i>

Professor/ Lecturer	
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Department and address	<i>DISSPA</i>
Virtual headquarters	<i>Microsoft Teams</i>
Tutoring (time and day)	Monday-Friday 8.30-13.30 by previous appointment Monday- Thursday 15.00-17.00 by previous appointment

Syllabus	
Learning Objectives	<i>The course aims to provide knowledge of the main sources of environmental pollution and agricultural systems, their mobility. Furthermore, it provides knowledge on the mechanisms of interaction with the main natural resources (soil, water) involved in agri-food production and on the use in agriculture of waste, by-products and wastewater of various origins and nature.</i>
Course prerequisites	<i>Principles of general, inorganic and organic chemistry.</i>
Contents	<p>INTRODUCTION. Concept and definitions of environmental chemistry. SOIL POLLUTION. Indicators and indexes of environmental quality, organization models.</p> <p>ENVIRONMENTAL CHEMISTRY. Molecules, elements and their impact on human toxicity. Biogeochemical cycles (C, N, P, S e water). Exogenous and endogenous cycles. Water, atmosphere, lithosphere and soil.</p> <p>ATMOSPHERIC CHEMISTRY AND POLLUTION. Physical characteristics and energy and mass transfer. Thermal inversion. Chemical and photochemical reactions. DPSIR Model applied to VIA Atmosphere component. Atmospheric pollutants, particles and effects to human health Inorganic pollutants. Carbon monoxide. Sulphur dioxide. Nitrogen oxides. Carbon dioxide and green house effect. Acid rains.</p> <p>SOIL CHEMISTRY AND POLLUTION. Soil components, physical and chemical properties and organic/ inorganic xenobiotics. Ionic retention, kinetics and exchange and sorption isotherms. Soil microand macro-elements. DPSIR Model applied to VIA Soil component. Heavy metals and organic xenobiotics. Soil degradation, erosion, salinization, sodicization and desertification. Wastes and pollutants in soil. Pesticides and xenobiotics.</p> <p>WATER CHEMISTRY AND POLLUTION. Phases interactions. DPSIR Model applied to VIA Hydrosphere component. Heavy metals and other inorganic species. Organic pollutants. Pesticides in waters. PCBs. Wastewater and drinking water processes.</p> <p>WASTES AND THEIR RECYCLING: Introduction to wastes. Waste materials: paper, plastics, glass and organic wastes. Biomass recycling and agricultural valorization (focus on wastes from the agricultural and food production field).</p>

	Food contamination. <i>Organic (pesticides, PCB, IPA) and inorganic (heavy metals) toxic residues. Release phenomena by material contacts</i>
Books and bibliography	<ul style="list-style-type: none"> Colin Baird, Michael Cann. <i>Chimica Ambientale</i>. 3° Ed., Zanichelli, 2013. P. Sequi (Coord.), <i>Fondamenti di Chimica del Suolo</i>, Patròn Editore, Bologna 2005. G. Cerutti. <i>Residui, additivi e contaminanti degli alimenti</i>. Tecniche Nuove, Milano, 1999. <p>APAT, IRSA-CNR. <i>Metodi analitici per le acque. Manuali e linee guida (29/2003)</i>.</p>
Additional materials	<i>Notes, slides and other bibliographic materials will be furnished during the course</i>

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/Self-study hours
Hours			
150	40	14	96
ECTS			
6	5	1	
Teaching strategy	<p><i>Lectures will be presented through PC assisted tools (PowerPoint, video). Field and laboratory classes, reading of regulations will be experienced.</i></p> <p><i>Lecture notes and educational supplies will be provided by means of teacher's webpage</i></p>		
Expected learning outcomes	<p><i>The expected learning outcomes, in terms of both knowledge and skills, are provided in Annex A of the Academic Regulations of the Degree in Food Science and Technology (expressed through the European Descriptors of the qualification)</i></p>		
Knowledge and understanding on:	<ul style="list-style-type: none"> ○ Knowledge of the main environmental pollution sources in agricultural systems ○ Knowledge of the uses of wastes and byproducts from agrifood systems ○ Knowledge of the mechanisms of adsorption and accumulation of pollutants in vegetables and foods 		
Applying knowledge and understanding on:	<ul style="list-style-type: none"> ○ Understanding phenomena of transfer and accumulation of contaminants in agri-food systems 		
Soft skills	<ul style="list-style-type: none"> • <i>Making informed judgments and choices</i> <ul style="list-style-type: none"> ○ Application to food processing of the acquired knowledge on prevention and control on pollution and contamination. • <i>Communicating knowledge and understanding</i> <ul style="list-style-type: none"> ○ Ability to describe environmental issues regarding food processing and to relate them to other disciplines • <i>Capacities to continue learning</i> <ul style="list-style-type: none"> ○ Skill of updating the knowledge of pollution and food contamination. 		
<p>The expected learning outcomes, in terms of both knowledge and skills, are provided in Annex A of the Academic Regulations of the Degree in Food Science and Technology (expressed through the European Descriptors of the qualification).</p>			

Assessment and feedback	
Methods of assessment	The exam consists of an oral dissertation on the topics developed during the theoretical and theoretical-practical lectures in the classroom and in the laboratory/production plants, as reported in the Academic Regulations for the

	<p>Master Degree in Food Science and Technology (article 9) and in the study plan (Annex A).</p> <p>Students attending at the lectures may have a middle-term preliminary exam, consisting of an written test, relative to the first part of the program, which will concur to the final evaluation and will be considered valid for a year.</p> <p>The evaluation of the preparation of the student occurs on the basis of established criteria, as detailed in Annex B of the Academic Regulations for the Master Degree in Food Science and Technology.</p> <p>The foreign student's profit test can be done in English in the way described above.</p>
Evaluation criteria	<ul style="list-style-type: none"> • <i>Knowledge and understanding</i> <ul style="list-style-type: none"> ○ The student will be able know and describe the properties of the FCM, to read and understand a technical sheet of the materials • <i>Applying knowledge and understanding</i> <ul style="list-style-type: none"> ○ Describe the possible applications of the materials of the food packaging. Able to understand the technical sheet of the materials • <i>Autonomy of judgment</i> <ul style="list-style-type: none"> ○ The student will be able Express reasonable hypotheses about choice of materials for packaging of food products presented during lectures • <i>Communicating knowledge and understanding</i> <ul style="list-style-type: none"> ○ The student will acquire communication skills and tools to analyse and discuss analytical data related to new process and products with interlocutors with similar and different backgrounds. • <i>Communication skills</i> <ul style="list-style-type: none"> ○ The student will be evaluated considering the use of appropriate technical language. • <i>Capacities to continue learning</i> <ul style="list-style-type: none"> ○ The students will be also evaluated considering the capacity to deepen and update their knowledge within the topics of the course also through efficient bibliographic research using the database scopus and google scholar.
Criteria for assessment and attribution of the final mark	<p>The evaluation criteria that contribute to the attribution of the final mark will be: knowledge and understanding, the ability to apply knowledge, autonomy of judgment, i.e. the ability to criticize and formulate judgments, communication skills</p>
Additional information	