UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze Agrarie, Alimentari e Forestali
ACADEMIC YEAR	2019/2020
BACHELOR'S DEGREE (BSC)	AGRICULTURAL ENGINEERING
SUBJECT	AGRICULTURAL CHEMISTRY
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50125-Discipline della produzione vegetale
CODE	18801
SCIENTIFIC SECTOR(S)	AGR/13
HEAD PROFESSOR(S)	LAUDICINA VITO ARMANDO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	8
INDIVIDUAL STUDY (Hrs)	132
COURSE ACTIVITY (Hrs)	68
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**LAUDICINA VITO ARMANDO** Wednesday 11:00 14:00 Dip. SAAF, 1° piano, studio 142

DOCENTE: Prof. VITO ARMANDO LAUDICINA

PREREQUISITES	Basic knowledge of inorganic and organic chemistry is required
LEARNING OUTCOMES	Knowledge and understanding skill: the student will acquire the skill to understand the nutrient dynamics into the soil. Skill in applying knowledge and understanding: the student will be able to utilize soil data to evaluate the soil fertility and to plan its sustainable use. Autonomy of judgement: the student will be able to interpret soil data and to foresee the soil suitability for a specific use. Furthermore, the student will be able to foresee the flux of soil nutrients. Communication skill: the student will be able to describe the soil properties and the results of a certificate soil analysis. Learning skill: the student will be able to go into the biogeochemical processes of soil nutrients by using textbooks and research articles published in the category of soil science.
ASSESSMENT METHODS	The evaluation is expressed in thirtieths: the minimum score is 18, the maximum score is 30 cum laude. The modalities with which the final evaluation is formulated depend on the knowledge of the topics and on the ability to deduce and process information, on the ability to apply the knowledge acquired also in contexts different from those proper of the teaching and on the ability to state with a specific language the acquired knowledge during the oral exam. The vote will be between a) 18-21 when the aforementioned knowledge and skills will be sufficient; b) 22-25 when the aforementioned knowledge and skills will be fair; c) 26-29 when the aforementioned knowledge and skills will be from good to excellent; d) 30-30 cum laude when the above knowledge and skills will be excellent.
EDUCATIONAL OBJECTIVES	The student will be provided with the tools to understand the soil resource and to carry out physical and chemical soil analyses. In particular, during the course, soil properties will be explained and discussed in order to understand the soil attitude to tillage, irrigation, crop choice and fertilisation. At the end of the course, the student will have acquired the required knowledges for the determination of the main physical and chemical soil properties and for the interpretation of soil data.
TEACHING METHODS	The course is structured in frontal lessons and laboratory exercises.
SUGGESTED BIBLIOGRAPHY	1.Sequi P., Ciavatta C., Miano T., 2017. Fondamenti di chimica del suolo. Patron Editore. Bologna. 2.Weil R.R., Brady N.C., 2016. The Nature and Properties of Soils, 15th edition. Pearson Education, Inc., Boston, USA.

SYLLABUS

Hrs	Frontal teaching
2	The concept of soil. Chemical composition of the soil. The soil as a multielementary and multi-component system. The soil as an open system. Soil limits. The concept of sustainable soil use. The functions of soil in the ecosystem.
2	Soil forming factors: climate, organisms, topography, pedogenetic substrate, time. The basic processes of soil formation: transformation, translocation, addition, loss.
5	The inorganic component of the soil. Definition of mineral, crystal, crystalline structure. Silicates: crystalline structure of silicates, classification of silicates. Isomorphic replacement concept. Clay minerals: group of kaolinite, montmorillonite, illite, vermiculite, chlorites. Clays with mixed layers. Oxides and hydroxides, carbonates, sulfates, halides, phosphates, sulfides.
2	The processes of physical alteration of minerals: thermoclasm, cryoclasm, root systems of plants, strength of salts crystallization, lightning discharge (vitrification of silicate rocks), abrasive action of liquid and solid water (movement of glaciers), wind, earthquakes, deep soil tillage.
4	The processes of chemical alteration of minerals: hydration, dissolution, partial and total hydrolysis of aluminosilicates (kaolinization and lateralization), redox reaction, carbonation, chelation, action of mineral acids. Causes of instability of minerals: bonds between silicon tetrahedra, isomorphic substitutions, bivalent iron, hydrogen ions absorbed in the silicate structure.
5	The organic component of the soil. The carbon cycle. Input of the organic substance. The constituents of the organic substance. The decomposition of the organic substance: mineralization, humification, fermentation or carbonification. Extraction and fractionation of organic matter. Functional groups of humic substances. Role and functions of organic substance. Soil organisms and their role in the nutrient cycle.
2	Soil colloids: mineral colloids (general characteristics and properties, flocculation and peptisation, gelling and gels), organic colloids and organo-mineral colloids.
2	The liquid phase of the soil: structure and properties of the water molecule, surface tension, the phenomenon of capillarity, water content and water potential. Adhesion and cohesion forces. Forms of water in the soil and hydrological constants. Water movement in the soil-plant-atmosphere system.
2	The gaseous phase of the soil: telluric air and its composition, gaseous exchange between soil and atmosphere, greenhouse gases emission from soil.
2	Physical properties of soil: real and apparent texture, aggregation state of soil particles, inorganic and organic cements, stability of aggregates, porosity, real and apparent density.

SYLLABUS

Hrs	Frontal teaching
4	The absorbing power of the soil: mechanical absorption, physical absorption, chemical absorption, biological absorption, chemical-physical absorption (ion exchange). Importance of the chemical-physical absorption. The soil exchange complex: inorganic and organic exchangers. The origin of negative (and positive) charges on soil colloids. The cation exchange: principles that govern exchange reactions (reversibility and stoichiometry, speed, obedience to the law of mass action, selectivity), cation exchange capacity, quantity and types of exchange bases, degree of saturation in bases. The anionic exchange: "non-specific" anionic adsorption, specific adsorption. Theory of the inner sphere and outer sphere complexes.
6	Soil reaction: pH and range of variation in soils. Acid soils, causes of acidification of soils, correction of acid soils. Submerged soils, main reactions of submerged soils. The alomorphic soils, causes of alkalinization, genesis of soils affected by salinity, determination of salinity and alkalinity, salty, saline-sodic and sodic soils, reclamation and management of saline, saline-sodic and sodic soils, calculation of the needs in gypsum.
6	The chemical elements of soil fertility: macronutrients and micronutrients. Nitrogen in the soil: oxidation stages, forms of nitrogen, inputs and losses, the nitrogen cycle (symbiontic and non-symbiontic fixation, ammonification, nitrosation, nitrication, denitrification). Phosphorus in the soil: forms of phosphorus, inputs and losses, availability of phosphorus at varying pH, phosphorus cycle in the soil-plant system, phosphorus mobilization. Potassium in the soil: potassium forms, injections and losses. Sulfur in the soil: forms of sulfur, cycle of sulfur.
4	_correctives, amendments, fertilizers. Reaction of the fertilizers. Title of the fertilizers. Release time of fertilizers. Nitrogen fertilizers_ ammonium nitrate, nitric, nitric-ammonia and amide. Phosphoric fertilizers_ phosphorite or natural phosphate, simple superphosphate, triple superphosphate, Thomas slags. Potassium fertilizers_ potassium chloride, potassium sulphate and potassium saline. Compound and complex mineral fertilizers. Binary fertilizers. Ternary fertilizers. Organic fertilizers. Organ-mineral fertilizers_

Hrs	Practice
3	Soil sampling. Soil preparation. Soil sieving.
3	Determination of soil reaction, electrical conductivity and total carbonates.
4	Determination of soil texture.
2	Determination of cation exchange capacity.
3	Determination of soil organic matter.
3	Determination of total nitrogen.
2	Reading a certificate of soil analysis