# .- Soil Chemistry

## Prof. Gian Maria Beone

### **COURSE AIMS AND INTENDED LEARNING OUTCOMES**

The aim of the course is to provide students with the basic knowledge of soil genesis, the chemistry of organic and inorganic components and their interactions, the cycles of nutrient elements, and the use of fertilisers. The ability to apply knowledge and understanding is also developed through group tutorials held in the laboratory and in the field. At the end of the course, students will know the general principles of the chemical, biological and physical processes taking place in the soil system. This knowledge is the basis for understanding the complex dynamics of soil formation, its evolution, and the ability to allow the development of plants for productive purposes. Another important course aim is to equip students with a mastery of the subject's scientific language and to provide the theoretical bases for further in-depth study on the topics covered in the course, through the self-consultation of specialised texts, and scientific and educational journals.

***COURSE CONTENT***

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|  | ECTS |
| **Soil system** |  |
| The main elements of the earth's crust. The rocks: classification, genesis, processes of disintegration and decomposition. Soil profile and its diagnostic horizons. Factors of pedogenesis and Jenny's equation. Application of the reading keys for Soil – Taxonomy and World Reference Base. Grain size and texture. Soil structure. | 1.25 |
| **Chemistry of silicon and clays** |  |
| The classification of silicates. Primary and secondary phyllosilicates. Genesis of clays. Physical-chemical properties of the soil: colloidal state, electrical charge, specific surface and surface charge density. | 0.75 |
| **Organic matter** |  |
| Classification, characterisation, and role of organic matter. Humic substances: chemical structure, genesis and characterisation. | 0.75 |
| **Adsorption and ion exchange** |  |
| Physical models of adsorption and exchange reactions. Cation adsorption: effect of valence, dilution and selectivity. Anionic adsorption: specific and non-specific adsorption. Freundlich isotherm. | 0.5 |
| **Liquid and gaseous phases of the soil** |  |
| Soil water. Degree of reaction and DBS (degree of base saturation). The buffering power of the soil. Redox potential and composition of telluric air. Irrigation water. | 0.5 |
| **Particular soils** |  |
| Management and correction of acidic and halomorphic soils. Submerged soils. | 0.5 |
| **Elements of fertility and fertilisation** |  |
| Principal elements, secondary elements, and microelements of fertility. The phosphorus, nitrogen, potassium, sulphur, and calcium cycles. Fertilisers: classification and titles. Nitrogen, phosphate, and potassium fertilisers. | 0.75 |
| **Classroom, laboratory and field tutorials** |  |
| Classroom: Theoretical explanations and preparation for laboratory and field tutorials (4 hours).  Laboratory: determination of pH, total limestone, texture estimation and soil colour (6 hours).  Field: practical technical tutorial with the compilation of the sampling form (2 hours). | 1.0 |

***READING LIST***

P. Sequi, C. Ciavatta, T. Miano, *Fondamenti di Chimica del suolo,* Patron Editore, Bologna, 2017 (hard copy or e-book).

D.G. Strawn, H.L. Bohn, G.A. O'Connor. Soil Chemistry. John Wiley & Sons, Incorporated, 2015 (e-book).

Alfred R. Conklin and Mark F. Vitha, Introduction to Soil Chemistry: Analysis and Instrumentation, John Wiley & Sons, Incorporated, 2014 (e-book).

***TEACHING METHOD***

1. Theoretical frontal lectures in which the main topics of the course will be addressed.
2. Classroom, laboratory, and field tutorials in which examples of planning and characterising a soil, from sampling to laboratory analysis, will be examined.
3. Students will participate in a practical technical tutorial with the compilation of the sampling form.
4. Students will conduct the laboratory activities in groups of 2-3, carrying out soil analyses (pH, salinity, total limestone, colour, and estimation of texture using manual tests). The analyses will cover the characterisation of certain soil profile developments.

***ASSESSMENT METHOD AND CRITERIA***

An oral assessment at the end of the course.

The oral exam, marked out of thirty, is designed to assess primarily the student's reasoning ability and analytical rigour with respect to the course subjects, as well as their command of the language. It consists of questions covering all the topics dealt with in class, including those from the tutorials. The oral exam result is communicated immediately following the end of the exam.

***NOTES AND PREREQUISITES***

Students must possess a basic knowledge of general, inorganic and organic chemistry.

Information on office hours available on the teacher's personal page at <http://docenti.unicatt.it/>.