# General and Systematic Botany

## Prof. Adriano Marocco; Prof. Alessandra Lanubile

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

Teaching takes place in the 1st and 2nd terms and is divided into 8.5 ECTS (68 hours) of frontal lectures and 2.5 ECTS (32 hours) of tutorials. The course aims to: 1) introduce the characteristics of plant cells, the formation and structure of plant tissues and organs and plant development; 2) study the endogenous and environmental factors that control development; 3) introduce the principles of plant physiology; and 4) teach the taxonomic criteria, the characteristics of the main families and the methods of species recognition.

***Knowledge and understanding***

At the end of the course, students will be able to:

Describe the main structures of plant cells and primary tissues;

Describe the primary and secondary structure of the stem and root, and the anatomy of the leaves, with reference to the differences between the main groups of plants;

Outline the phases of the cell cycle and cell division that are specific to plants and describe the development of the male and female gametophytes in an Angiosperm and the sequence of events from fertilisation, to the development of the embryo, the endosperm, the seed and, finally, the formation of the fruit;

Explain how the activity of meristems generates the organisation of plant tissues and organs;

Summarise the effects of environmental factors on seed germination, seedling development and flowering, considering the action of photoreceptors and growth regulators;

Explain how water and minerals are absorbed by the soil and move towards the leaves, and summarise the mode of transport of phloem lymph;

Define the concept of symbiosis and provide details on the formation of nodules and mycorrhizae on plant roots;

Describe the factors that influence phytogeography, the distribution areas of terrestrial plants, the chorotypes; summarise the biological forms, the biomes and the Italian vascular flora;

Distinguish between the main groups of Spermatophytes, and summarise the characteristic aspects of Angiosperms and of the main families of Italian flora.

***Applying knowledge and understanding***

At the end of the course, students will be able to:

Compare and distinguish the main structures of stems, roots, leaves, seeds and fruits that characterise the different plant species;

Know the endogenous and environmental factors that regulate plant development;

Demonstrate operational knowledge in the identification of cultivated and spontaneous plant species of Italian flora;

Design and create herbariums, prepared with scientific methods and aims, according to international criteria.

***COURSE CONTENT***

1st Term

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|  | ECTS |
| *The cellular level*.  The cell, the membranes, the cellular part, the cytoskeleton, the endomembrane system, the vacuole, the plastids, the nucleus. | 1.0 |
| *The tissue level*.  Primary and secondary meristematic, tegumental, mechanical, conductive and secretory tissues. | 1.0 |
| *The organ level*.  The stem: primary structure, differentiation of the vascular cambium and cork carbium and the passage to the secondary structure. The leaf: morphology, anatomy, particular types of leaves, leaf modifications. The root: organisation of the primary structure zone and the secondary structure zone. | 2.0 |
| *The organism level*.  Sexuality in plants. Sexual reproduction, gametogenesis, fertilisation, embryonic development, seed and fruit development. Outline of incompatibility systems, apomixis, regenerative processes and cellular totipotency. | 1.0 |
| *Tutorials.* Optical microscope observation of the tissues and of the primary and secondary body of roots, stems and leaves. | 0.5 |

2nd Term

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|  | ECTS |
| *Development, morphogenesis and adaptation*.  The stem: ontogenesis and differentiation. The leaf: origin, development and phyllotaxis. The root: organisation of the root apex, area of differentiation, adventitious roots. The flower: the combinatorial model of the floral organs.  Environmental stimuli and tropic (phototropism and gravitropism), nastic, morphogenic and photoperiodic responses. Cryptochromes and phytochromes. Circadian rhythms and the endogenous clock. Growth regulators and the physiology of hormonal action. | 1.5 |
| *Metabolism*.  Turgor and cell growth, the physiology of long-distance transport (mechanisms of stomatal action, transpiration and xylem transport; phloem transport). Mineral nutrition: essential elements, macro and micro elements, brief notes on the characteristics of ion absorption by the roots. Mycorrhizae and nitrogen-fixing symbioses. | 1.5 |
| *The general criteria of* *systematics*.  Elements of taxonomy, the binomial nomenclature, the main features of Cormophytes. Elements of phytogeography. | 0.5 |
| *Tutorials.*  The general characteristics of the main families of agronomic interest and the identification of species with the use of keys and herbariums. Preparation of a herbarium with dried specimens. | 2.0 |

***READING LIST***

A.M. Smith-G.Coupland-L. Dolan-N. Harberd-J.Jones- C. Martin-R. Sablowski-A. Amey, *Biologia delle piante*, Zanichelli, Bologna, 2011 (part 1), 2012 (part 2)

G. Pasqua G. Abbate C. Forni, *Botanica generale e diversità vegetale*, Piccin, Padua, 2008

A. Speranza-G.L. Calzoni, *Struttura delle piante in immagini,* Zanichelli, Bologna, 1996.

***TEACHING METHOD***

1. Theoretical frontal lectures and dialogues, with the aid of PowerPoint presentations, in which the key concepts of the subject are presented with different application examples;
2. The 1st term tutorials will involve the optical microscopic observation and identification of anatomical preparations of the roots, stems and leaves of Monocotyledonous, Dicotyledonous and Gymnosperm plants.
3. The 2nd term tutorials will involve the description of the main plant families of agricultural and food interest, and practical experience in the recognition of plant species based on the use of guides, dichotomous keys and stereo-microscopic observations of the various diagnostic features. They will conclude with the preparation of a herbarium of at least 30 dried specimens.

***ASSESSMENT METHOD AND CRITERIA***

There is both a written and an oral exam. The written test is interim in nature and is based on the ECTS covered in the 1st term, involving the recognition and description of two histological preparations under the microscope and two open-ended questions. The duration of the test is 120 minutes. Based on the completeness and clarity of the description of the preparations, a maximum of 7.5 marks will be awarded for each question. The minimum overall mark to pass is 18/30. Failure to complete or pass the written test will result in the student taking the same test during the final exam.

The final oral exam includes the recognition of a randomly assigned plant in the discussion of the herbarium, and 2-3 questions related to the ECTS covered in the 2nd term. The final mark is based on the weighted average of the marks obtained for the interim test, the discussion of the herbarium and the oral exam questions, and will consider the student's level of detail and command of the language.

NOTES AND PREREQUISITES

Being introductory in nature, there are no prerequisites for attending the course. It is particularly advisable to attend the practical activities involving microscopic observations and the setting up of the herbarium.

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

In case the current Covid-19 health emergency does not allow frontal teaching, remote teaching will be carried out through synchronous or asynchronous procedures that will be promptly notified to students