# Ecosystems, Environmental Physical Chemistry and Impact Assessment

## Prof. Andrea Ferrarini, Lucrezia Lamastra

# Module I – Ecosystems

## Prof. Andrea Ferrarini

***COURSE AIMS AND INTENDEND LEARNING OUTCOMES***

### The course aims providing to students a general understanding of ecology as complex scientific discipline, capable of quantitatively analysing the natural ecological systems but also of dictating principles and practices to start the ecological transition of production and consumption models as well as the human-modified ecosystems. These are topics of great relevance, such as climate change, or of relevance for the immediate application effects, such as the conservation of biodiversity, bio-based economy, the functions of ecological systems.

### Upon completion the students will be able to:

### - Analyse the structure of ecosystems and eco-systemic processes and address the main issues of sustainable ecosystem management, the use of natural resources and nature conservation;

### - Will also have the ability to use concepts and data to solve basic problems related to ecological applications to environmental issues.

### **COURSE CONTENT**

1. *History and nature of ecology*: organization of ecological systems; quantitative ecology and scientific method. Ecology and sustainable development. Global challenges and SDGs.
2. *The ecosystem*. Ecosystem concept. Ecosystem structure. Food chains. Primary production. Consumers. Detritivores and consumers. Ecological metabolism and pyramids. Carrier capacity theory.
3. *Ecosystem services (ES): the planetary boundaries, ES definitions, categories and evaluation methods*
4. *Environmental conditions* and adaptation of organisms: habitat, niche, stress and resilience to stress and climate change.
5. *Population and communities ecology*: structure, growth, limitations; prey-predator interactions; adaptations, perturbations, resilience.
6. *Ecosystems functioning*: the carbon cycle and the link between abiotic and living systems. Reactions, processes and factors limiting primary production. Energy transport models in ecosystems.
7. Main *bio-geochemical cycles* in natural environments and agro-systems.
8. *Human ecology*: history of the human-environment relationship, hints of circular and bio-based economy, climate change, conservation of biodiversity, the ecological transition.

**READING LIST**

Smith T.M. & Smith R.L. 2013. Elementi di Ecologia. 8° edizione. Pearson Italia, Milano-Torino.

Readings (reports, papers) and slides of the lessons will be made available on Blackboard.

### **TEACHING METHOD**

The teaching will take place through lectures and analysis of case studies of natural and anthropic ecosystems. Researchers who carries out research on these issues will be invited to give seminars during the lessons (4 hours).

***ASSESSMENT METHOD AND CRITERIA***

## The evaluation methods of the knowledge and skills acquired are: a) for the institutional content of the course, a *written exam* with open questions and multiple choice questions. The maximum achievable score is 28/30, which will be integrated by the points achieved in the seminar activity; b) for the seminars, a *report* of the presentations given by researchers is expected and the score varies from 1 to 2 points.

## The exam aims at evaluating the ability to understand, the use of the theoretical and practical tools presented during the course for ecological analysis, as well as the ability to argue with scientific lexicon the results and experiences presented during the seminars.

## The exam can be taken at the end of the lessons of the first semester in the session dedicated to the intermediate tests or during the official appeals of the course scheduled at the end of the second semester. The overall evaluation of the course derives from the average of the evaluations achieved in the tests relating to the two modules.

#### NOTES AND PREREQUISITES

No prerequisites are required for successful course’s participation.

Prof. Andrea Ferrarini is available to meet with students every day, by appointment, at the Department of Sustainable Crop Production. Information on office hours available on the teacher's personal page at: <http://docenti.unicatt.it/>

# Module II: Environmental physical chemistry and impact assessment

Prof.ssa Lucrezia Lamastra

***COURSE AIMS AND INTENDEND LEARNING OUTCOMES***

The course is aimed at providing basic concepts to understand the chemical and physical laws that regulate the environment and related impacts and alterations. Furthermore, the course introduces the main assessment tools that can be used to address sustainable management of human activities considering the interactions with the environment and its resources.

At the end of the course the student will be able to:

- Understand the scientific basis of sustainability;

- Adopt a systemic and transdisciplinary approach essential to face the complexity of environmental problems;

- Apply the tools of life cycle assessment and use them to evaluate the impacts of human activities;

- Interpret and evaluate the data of environmental impact studies;

- Solving problems and exercises related to the theoretical aspects covered in the course;

- Expose their knowledge in a clear way, with appropriate language;

- Work independently.in small groups.

***COURSE CONTENT***

1. Environment, environmental issues and pollution;
2. Climate: greenhouse effect, stratospheric ozone;
3. Water: hydrogeological cycle, pollution of surface and groundwater bodies, acidification of the oceans;
4. Soil: land use change, desertification, soil pollution;
5. Sustainable use of resources;
6. Renewable and non-renewable resources:
7. Methods and tools for the circular economy:
8. Life cycle assessment and other tools to measure environmental impacts;
9. Theoretical and practical aspects related to the environmental impacts measures.

***READING LIST***

- Colin Baird, Michael Cann, Chimica Ambientale, Ed. Zanichelli 2013

- Slides and teaching materials available on blackboard

***TEACHING METHOD***

The teaching methods are:

1) Theoretical lessons, and application examples The lessons will be held with the support of slides and / or blackboard.

2) Seminars on monographic topics with the participation of experts (6 hours, 0.75 credits).

***ASSESSMENT METHOD AND CRITERIA***

The exam consists of a written test and of a report on a case study carried out in small groups (maximum 3 students / group). The written test contains 10 multiple choice questions (2 points each one) and 2 open questions (4 points each one) for a total of 28/30. The questions will be related to the entire program and will concern both theoretical and practical aspects. The duration of the test will be 1h and the results will be delivered on blackboard. The evaluation of the report on the case study will integrate the outcome of the written test, contributing with 1 or 2 points. The written exam is aimed at evaluate the understanding of the theory (multiple choice questions), but also, through open questions and the writing of report on case study, if the student has acquired the ability to critically analyse an environmental problem in a clear way, with appropriate language. Furthermore, drafting the report in small groups will allow to evaluate the ability to work in a team.

#### NOTES AND PREREQUISITES

No prerequisites of skills are required for successful participation in teaching. Information on office hours available on the teacher's personal page at: <http://docenti.unicatt.it/>