# Foundations of complex systems for sustainability and governance

**Academic Year: ( 2022 / 2023 )** **Review date: 21-05-2022**

**Department assigned to the subject: Mathematics Department**

**Coordinating teacher: SANCHEZ SANCHEZ, ANGEL**

**Type: Compulsory ECTS Credits : 6.0**

**Year : 1 Semester : 1**

## OBJECTIVES

¿ Understanding about the governance of sustainable development (SD) at the local, regional, national, global and supranational levels. Analysis of the challenges of sustainability and governance from a critical and interdisciplinary point of view.
¿ Acquisition of a basic understanding of complex systems in the context of sustainability and its governance.
¿ Knowledge of the main concepts of environmental science, including ¿the earth system¿, its main components; critical assessment regarding the importance of those components for global, national and local environmental governance and public policies.
¿ Acquisition of analytical tools to explore the links between climate change, challenges of biodiversity and their consequences for SD; ability to analyze various implications of adapting sustainable strategies and conserving biodiversity in different geographies and countries with different income levels and political regimes.
¿ Understanding of the paradigm of complex systems and emergent phenomena, including the key ingredients of complexity: chaos, nonlinearity, many agents, feedbacks.
¿ Knowledge about how to work with complex system problems for sustainability: unintended consequences, tailored interventions.

## DESCRIPTION OF CONTENTS: PROGRAMME

1.The paradigm of complex systems: emergent phenomena and the failure of reductionism.
2.The ingredients of complexity: chaos, nonlinearity, many agents, feedbacks.
3.Complex networks.
4.Examples of complex systems in physics, nature and society.
5.Dealing with complex system problems for sustainability: unintended consequences, tailored interventions.

## LEARNING ACTIVITIES AND METHODOLOGY

Class lectures by the teacher with the support of computer and audiovisual media, in which the main concepts of the subject are developed and the bibliography is provided to complement the students' learning.
Critical reading of texts recommended by the professor of the subject: press articles, reports, manuals and/or academic articles, either for subsequent discussion in class, or to expand and consolidate the knowledge of the subject.
Resolution of practical cases, problems, etc. .... posed by the teacher individually or in groups.
Presentation and discussion in class, under the moderation of the professor, of topics related to the content of the subject, as well as case studies.
Elaboration of works and reports individually or in groups.

## ASSESSMENT SYSTEM

¿ A 10% of the final grade corresponds to the evaluation of the active participation of each student in the debates in class and the resolution of the problem sets.
¿ A 30% of the final grade corresponds to the mid-term that is taken in the middle of the course approximately.
¿ A 60% of the final grade corresponds to the final exam. Both the mid-term and the final exam are based on questions and exercises related to the theoretical concepts covered in class and on questions related to the discussion included in the papers marked as compulsory readings.

BASIC BIBLIOGRAPHY

- Alan Garfinkel, Yina Guo, Jane Shevtsov Modeling Life, Springer Nature, 2017
- Donella H. Meadows Thinking in Systems, Earthscan, 2009