UAB
Universitat Autònoma de Barcelona

Environmental Modelling

Code: 106772
ECTS Credits: 6

2025/2026

Degree	Type	Year
Environmental Sciences	OP	4

Contact

Name: Carles Barril Basil

Email: carles.barril@uab.cat

Teachers

Teodoro Mayayo Cortasa

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

The contents of the subject Basics of Mathematics.

Objectives and Contextualisation

In this subject the theory of dynamical systems is introduced with the goal to analyse enviromental problems and assess the impact (on sustainability, on the ecosystems, on the human health and/or on the economy) of the enviromental policies that can cope with them.

The aim is for students to:

1. Recognize variables, hypotheses and important parameters in problems of the real world.
2. Formulate mathematical models for different problems related to environmental processes.
3. Know how to identify different types of models.
4. Obtain the solutions in an exact or approximate way using analytical or numerical tools.
5. Know how to interpret and visualize the obtained solutions.
6. Know how to contrast the mathematical results with the propertiesobserved in the real problem.

Learning Outcomes

1. CM37 (Competence) Present proposals for the prevention and mitigation of the impact on the physical environment of natural or anthropogenic action, including that based on green chemistry.

2. CM38 (Competence) Distinguish the most appropriate mathematical tools and models to describe the dynamics of specific environmental processes.
3. KM46 (Knowledge) Identify the most important chemical and geological processes in the different environmental compartments (hydrosphere, soil and atmosphere).
4. KM47 (Knowledge) Recognise the way in which human activity has an impact on the function of physical vectors (water, soil, oceans, atmosphere) in the natural environment.
5. SM45 (Skill) Apply basic mathematical tools and models to describe the dynamics of environmental processes.

Content

1. Discrete time models

- Population models with seasonal reproduction.
- Management of renewable resources.

2. Continuous time models: ordinary differential equations

- Population models with non-seasonal reproduction.
- Phase portraits.
- Linear and non linear models. Linearization.
- Bifurcation diagrams.
- A greenhouse model. The histeresis effect.
- Aquifer contamination and bioremediation.

3. Introduction to partial differential equations

- Conservation equations. The advection-diffusion equation.
- Air pollution caused by an industrial plant.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	32	1.28	CM37, CM38, KM46, KM47, SM45, CM37
Practical session	9	0.36	CM38, SM45, CM38
Problem session	9	0.36	CM38, KM47, SM45, CM38
Type: Autonomous			
Solving problems and studying theoretical concepts	32	1.28	CM37, CM38, KM46, KM47, SM45, CM37

In the process of learning the subject is fundamental the homework of the student who at all times will have the help of the teacher.

The contact hours are distributed in:

- Lectures: The teacher introduces the corresponding basic concepts in the subject of the subject by showing several examples of its application. The student will have to supplement the teacher's explanations with the personal study.
- Problem session: The understanding and application of the concepts and tools introduced in the theory class, with the realization of exercises. The student will have lists of problems, a part of which will be solved in the problem classes. The rest will have to be solved by the student as part of his autonomous work.
- Practical session: The student will use packages of symbolic and numerical calculation programs. The practice classes will be held in the same classroom where the theory is done; students must bring their laptop to both problem classes and hands-on classes. In these classes the application of mathematical tools will be applied to models that require the use of computer software.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of problems	30%	32	1.28	CM38, SM45
Final project	20%	24	0.96	CM38, SM45
Mid-term tests	50%	12	0.48	CM37, CM38, KM46, KM47, SM45

Continuous assessment

Students will be asked for 3 problem submissions, one for each topic; 30% of the grade will be assessed and counted.

There will be two partial exams with a grade value of 25% each. An average of at least 4 of the two partials must be taken to be able to average with the other assessment activities.

A final project will be requested which will count for 20% of the grade.

Unique assessment

Students who have accepted the unique assessment modality will have to take a final test which will consist of a written exam that will consist of problem solving and some theoretical question. When finished, the student will hand in all the exercise assignments and the final project.

The final grade is obtained as follows: the exam counts 50%, the delivered problems 30% and the final project 20%.

To pass the course, the exam grade must be greater than 4 (on a scale of 10), and the final average (exams and other assessment tests) must be greater than 5

Recovery exam

It is possible to do an additional exam to recover the grade of the exams (corresponding to 50% of the course grade). The mark of this exam replaces the mark obtained in the partial exams or in the final exam.

Bibliography

Basic:

- Gurney, William, and Roger M. Nisbet. *Ecological dynamics*. Oxford University Press, 1998.
- R. Martínez i Barchino. *Models amb equacions diferencials*. Vol. 149. Univ. Autònoma de Barcelona, 2004.

Complementary:

- J.D. Murray, *Mathematical Biology*, Springer-Verlag, 1993.
- M. de Lara, L. Doyen. Sustainable Management of Natural Resources, Mathematical Models and Methods. Springer-Verlag.
- N. hritonenko, Y. Yatsenko. Mathematical Modeling in Economics, Ecology and the Environment. Springer.
- S. H. Strogatz, *Non linear dynamics and chaos with applications to Physics, Biology, Chemistry and Engineering*, Westview Press, 2011

Software

Maxima

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed