COURSE DATA

DATA SUBJECT

Code: 43275
Name: Modeling
Cycle: Master's Degree
ECTS Credits: 3
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period

SUBJECT-MATTER

Degree	Subject-matter	Character

COORDINATION

GUERRERO CORTINA FRANCISCO

SUMMARY

This subject is included in the Master of Biodiversity within the set of subjects that provide the basic tools for the work of a biologist related to complex systems such as ecosystems. In this subject the student's mathematical knowledge is expanded in the aspects closest to real work, such as: statistical methods, numerical methods, General Systems Theory, construction of mathematical models and simulation, in order to achieve quasi-optimal-strategies of control over the evolution of ecosystems.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It is recommended to have basic knowledge of Statistics and Probability and Calculus.

COMPETENCES / LEARNING OUTCOMES

2148 -

Awaken interest in the social and economic application of science.

Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.

Be able to access to information tools in other areas of knowledge and use them properly.

Be able to communicate and disseminate scientific ideas.

Be able to make quick and effective decisions in professional or research practice.

Encourage ethical commitment and environmental awareness.

Favour intellectual curiosity and encourage responsibility for one's own learning.

Stimulate the capacity for critical reasoning and for argumentation based on rational criteria.

To acquire basic skills to develop laboratory work in biomedical research.

To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.

DESCRIPTION OF CONTENTS

1. Statistical methods

Presentation of data: tables and graphs.
Measures of central tendency and dispersion.
Probabilities: conditional probability, Bayes' theorem.
Discrete random variable: Binomial and Poisson distributions.
Continuous random variable: normal distribution, Chi-square, T-Student.
Confidence intervals.
Hypothesis testing.
Regression and correlation.

2. Numerical methods and programming

Polynomial interpolation.
Numerical integration of functions.
Numerical integration of differential equations.
Fundamentals of programming.

3. Modelling and simulation

Types of models. Analytical approach and systemic approach.
Introduction to system dynamics.
Basic mathematical notions for system dynamics I.
Behavioral archetypes of dynamic systems.
Creation of computer models.
Use of models in various fields.
Basic mathematical notions for system dynamics II.

4. Practical sessions

Practical session 1: Confidence intervals and contrasts.
Practical session 2: Linear regression model.
Practical session 3: Numerical integration of functions and ODEs.
Practical session 4: Predator-prey model.
Practical session 5: Model created by the student.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Total hours	**0,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	14,00
Independent study and work	11,00
Preparation of lessons	8,00
Preparation for assessment activities	10,00
Resolution of case studies	2,00
Total hours	**45,00**

TEACHING METHODOLOGY

- **Theoretical module**. 20 hours in a conventional classroom (with blackboard and projection media). In these hours the essence of the programmed statistical, numerical and systemic methods will be explained, examples will be given and the students will solve equivalent problems. The interaction with the teacher will be constant. It is about replacing the master class with the presentation of a method with its theory and an example of its application by the teacher, and putting it into practice by the students immediately working in small groups, in order

to explain details each other while the teacher visits the different groups during their work. Students are expected to make their own notes starting from the material provided by the teacher and expanding it with the bibliography.

- **Practical module**: 10 hours in a computer room where the practices related to theory will be carried out. Students must prepare a report for each practice, as well as a final presentation of a model chosen for this purpose and different for each student.

EVALUATION

In the first assessment period, the evaluation will be as follows:

1. Attendance to class with achievement and study. For this, the notes taken during the classes will be presented and expanded, if necessary, with the use of the bibliography. It is intended that they develop a summary manual that will be useful to them as a reference tool in the future. It will be scored with a score from 0 to 10. Grade A.
2. Reports of the practices carried out in the computer classroom in which everything worked during them is explained in detail, with special emphasis on the deduction of the conclusions. They are delivered individually. Grade B.

The final grade will be the result of the formula:

Final grade = 0.1*Grade A + 0.9*Grade B

In the second assessment period the evaluation will be slightly different:

1. Grades A and B remain from the first assessment period.
2. There will be an individual written test on the theoretical and practical contents of the course. Grade C.

The final grade will be:

Final grade = 0.1*Grade A + 0.4*Grade B + 0.5*Grade C.

REFERENCES

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- López L, Martínez S (2000) Iniciación a la Simulación Dinámica. Ariel Economía. Barcelona.
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- Hannon B, Ruth M (1997) Modeling Dynamic Biological Systems. Ed. Springer Verlag. New York.
- Ruiz_Maya Pérez L,Martín_Pliego López FJ (2005) Thomson Paraninfo. Madrid.