Universitat Autònoma de Barcelona

2019/2020

Mathematics

Code: 100745
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	FB	1	1

Contact

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Use of Languages

Principal working language: catalan (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

Teachers

Jaume Aguadé Bover

José González Llorente

Prerequisites

- Rational and real numbers, numerical approximation and exponential notation. Absolute value and inequalities.
- Elementary functions: linear, polynomial, rational, exponential, logarithmic and trigonometric.

Objectives and Contextualisation

This program has a double objective. The first is to give the student a basic mathematical training, focused on linear algebra and one real variable calculus: derivation, integration and simple differential equations, which allows to understand the language of Science. The second is to introduce mathematical modeling of Biology, by means of simple examples that can be analyzed with the mathematical tools available to students.

With this idea most of the contents will be presented motivated by scientific problems, usually from the field of Biology. In particular Population Dynamics and Ecology that are the most matematizable areas of Biology at an elementary level. Linear algebra will be addressed as the natural tool for the study of the linear growth and age-structured populations, while differential equations will be introduced as the fundamental tool for the study of the magnitudes that change with time continuously, biological populations, as well as concentrations of chemical substances, for example.

In short, the objective is that students see mathematics as a essential tool to describe most of the physical phenomena.

Competences

- Be able to analyse and synthesise
- Be able to organise and plan.
- Develop independent learning strategies.

- Understand, interpret and use mathematical and statistical tools to solve problems in biology.
- Work in teams.

Learning Outcomes

1. Be able to analyse and synthesise.
2. Be able to organise and plan.
3. Describe natural phenomena in terms of mathematics.
4. Develop independent learning strategies.
5. Formulate common problems mathematically.
6. Interpret classical models of population growth .
7. Model problems in biology mathematically.
8. Use a scientific discourse for biology.
9. Work in teams.

Content

1. Functions and derivatives

    1.1 Linear functions. Polynomial functions. Rational functions. Exponential functions. Inverse function. Logarithmic functions. Graphics

    1.2 The derivative: tangent and velocity.

    1.3 Growth. Optimization. Graphics revisited.

2. Integral calculus

    2.1 The integral. The fundamental theorem of calculus. Primitives. Applications

3. Linear algebra

    3.1 Systems of linear equations. Matrices.

    3.2 Eigenvalues and eigenvectors. Diagonalisation.

    3.3 Discrete population dynamics: iteration. Dependence on age

6. Differential equations

    6.1 Differential equations of separate variables. Exponential growth. Balance of matter. The logistic differential equation.

    6.3 Geometric interpretation of differential equations. The problem of initial value.

    6.4 The qualitative method: balances and stability.

Methodology

The student acquires the scientific knowledge of the subject by attending theory lectures and learns to use them in problem lectures. We must reinforce this knowledge through the personal study of the theoretical part to be able to apply it to the exercises.

The realization of exercises is one of the most important tasks of the study, they illustrate and motivate all the theoretical development. On the other hand, the objective of the subject is that students learn to use mathematics as a working tool and therefore learn to face different types of problems modeling it or turning them into a mathematical question that they can solve.

Theoretical lectures will be reinforced with as many applied examples as possible and in addition the student will be asked to give periodic exercises that will be focused on facing the student with these modeling tasks.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises	15	0.6	3, 6, 7, 5, 1, 9, 8
Theory	35	1.4	3, 6, 7, 5, 1, 9, 8
Type: Supervised			
Tutoring	5	0.2	3, 5, 8
Type: Autonomous			
Exercises	35	1.4	3, 4, 5, 1, 9
Study	35	1.4	4, 5
Tests	15	0.6	4, 5, 2

Assessment

The final grade will be obtained from different parts.

- Two partial assessments contributing 30% + 40%. It will be necessary a grade of at least 3 over 10 in the second partial test to avoid the recovery test.
- Individual delivery of exercises (30%).
- Global review / recovery of the whole subject (70%) *

To participate in the recovery, the students must have previously been evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject or module. Therefore, students will obtain the "Non evaluable" qualification when the assessment activities carried out have a weighting of less than 67% in the final grade.

Delivery of exercises is mandatory. The students will obtain the "Non evaluable" qualification when the number of deliveries is less than 80% of the scheduled deliveries.

The repeating students will have to do the same assessment activities as new entry students.

The Honor Grade can only be awarded to students who have obtained a final grade equal to or greater than 9. They can be awarded a maximum of 5% of the students enrolled.

(* This exam is not mandatory and can be used both to upgrade, and to recover the grade obtained in the partial tests).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises delivery	30%	2	0.08	3, 4, 7, 5, 1, 2, 8
First partial exam	30%	2	0.08	3, 4, 6, 7, 5, 2, 9, 8

Recovery exam	70%	3	0.12	6, 7, 5, 1, 8
Second partial exam	40%	3	0.12	3, 6, 7, 5, 1, 8

Bibliography

There are no texts in the literature that adapts exactly to the content of the course. For this reason, three general-purpose texts are proposed that cover most topics and in which mathematical concepts are introduced intuitively and illustrated with many practical examples. These three texts are complemented by books that allow you to explore the most important topics of the course.

General bibliography

- *Matemàtiques i modelització per a les Ciències Ambientals,* Jaume Aguadé. *(*UAB, recursos electrònics http://ddd.uab.cat/record/158385)
- *Curso práctico de Cálculo y Precálculo,* Pestana i altres. (Ed. Ariel)
- *Introducción al Álgebra Lineal,* H. Anton (Editorial Limusa)

Complementary bibliography

- *Calculus, Tomo I.* S. Salas i E. Hille (Editorial Reverté)
- *Aplicaciones del Álgebra lineal*, Grossman, S. I. (Grupo Editorial Iberoamericano)
- *Matemáticas básicas para biocientíficos,* E. Batschelet (Editorial Dossat)
- *Matemáticas para ciencias,* C. Neuhauser (Editorial Prentice Hall)
- *Mathematics for the Biological Sciences.* J.C. Newby (Clarendon Press)
- *Matemáticas para Biólogos,* K.P. Hadeler, (Editorial Reverté)