# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 33039 |
| **Name** | Mathematics I |
| **Cycle** | Grade |
| **ECTS Credits** | 6.0 |
| **Academic year** | 2018 - 2019 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1100 - Degree in Biology | Faculty of Biological Sciences | 1 | First term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 1100 - Degree in Biology | 1 - Mathematics | Basic Training |

**Coordination**

| Name | Department |
|---|---|
| BELTRAN SOLSONA, JOSE VICENTE | 205 - Geometry and Topology |
| MASCARO BONNIN, FRANCISCA | 205 - Geometry and Topology |

# SUMMARY

The module **Mathematics I** is part of the scientific background to be acquired by every student of Biology before fully entering into the core of the degree.
This module tries to fill the gaps in mathematical knowledge that many students who enter university have and have not taken second year mathematics at high school.
Thus, the module begins with an introduction where we review some issues as operations with numbers and vectors, elementary functions, graphs of functions and their interpretation, and so on.
Also the module gives the basic math skills for any experimental science as:
a) Differential and integral calculus necessary to understand the math involved in issues related to speed, slope, determining maximum and minimum, measuring areas, etc.
b) An introduction to differential equations, with more emphasis in the concept and meaning of its solutions than in the resolution methods.

c) An introduction to the mathematical methods used in some specific areas of biology.

## 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 required, that the student has the skill in math calculation at the level of first-year mathematics at high school.
It is recommended, that the student has the knowledge of second year mathematics at high school.

## COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

### 1100 - Degree in Biology

- Capacidad de pensamiento lógico-matemático.
- Utilización del lenguaje matemático y estadístico.
- Aplicar conceptos matemáticos a casos prácticos de índole biológica.
- Distinguir las propiedades de los distintos tipos de funciones matemáticas básicas.
- Saber representar gráficamente funciones matemáticas básicas.
- Comprender el concepto de derivada y su uso para determinar los intervalos de crecimiento y decrecimiento de una función.
- Saber discutir la existencia o no de soluciones de un sistema de ecuaciones lineales y poder calcularlas.
- Comprender el concepto de integral de una función y su relación con el área comprendida bajo la misma.
- Saber calcular las soluciones de las ecuaciones diferenciales más sencillas.

## LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

**Learning outcomes**:
- To understand well and use fluently basic math concepts.
- To solve biological problems using advanced mathematical concepts.
- To understand the mathematical formalisms that may arise in biology.
- To model biological phenomena using mathematical tools.
- To interpret the mathematical results got when applied to the biological world.

**Skills to be acquired**:

- To be able to perform basic operations with real numbers and matrices.
- To know how to discuss the existence of solutions of a system of linear equations and how to compute them.
- To understand the concept of derivative and its use to determine the intervals where a function increases or decreases.
- To understand the concept of integral of a function and its relation to the area under its graph.
- To know how to get the solutions of easy differential equations.
- To know how to use a program to do mathematical calculus.
- Correct and clear statement (oral and written) of questions which have scientific content.
- Logical reasoning and critical ability.

## DESCRIPTION OF CONTENTS

### 1. Numbers and functions

1.1 Numbers: N, Q, R and C. Operations with complex numbers. Scientific notation.
1.2 The plane R2 and the space R3. Vectors. Equation of a line in the plane. Slope of a line. Distance in R2 and R3.
1.3 Functions. Graph of a function. Inverse of a function. Review of elementary functions. Exponential, logarithmic and polynomial growth.

### 2. Matrices. Solving linear equation systems

2.1 Matrices.
2.2 Determinant of a matrix.
2.3 Solving linear equation systems.

### 3. The derivative

3.1 The derivative of a function as velocity. Calculation of derivatives.
3.2 The derivative of a function as slope.

### 4. Optimization

4.1 Critical points for one variable functions.
4.2 Absolute maximum and minimum values.
4.3 Local maximum and minimum values.
4.4 Concavity and convexity.
4.5 Graphing with calculus.

### 5. Integration of one variable functions

5.1 Primitives or antiderivatives.
5.2 Some methods of integration.

### 6. Definite integral

6.1 Definite integral. Relation with improper integral.
6.2 Evaluating definite integrals. The fundamental theorem of calculus.
6.3 Applications of integration.

### 7. Introduction to differential equations

7.1 Modeling with differential equations.
7.2 First order differential equations.
7.3 Explicit solutions for separable differential equations.
7.4 Examples of differential equations that arise in biological problems.

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 31,00 | 100 |
| Computer classroom practice | 26,00 | 100 |
| Tutorials | 3,00 | 100 |
| Study and independent work | 21,00 | 0 |
| Preparation of evaluation activities | 16,00 | 0 |
| Preparing lectures | 25,00 | 0 |
| Preparation of practical classes and problem | 25,00 | 0 |
| Resolution of online questionnaires | 3,00 | 0 |
| **TOTAL** | **150,00** | |

## TEACHING METHODOLOGY

This module is usually taught in a two one-hour lecture per week (non-compulsory) where the lecturer will introduce gradually the contents of this module using as much examples and specific problems (biological in nature as far as possible) as possible. In addition, he will propose to students some activities that require understanding of concepts and techniques learned in lectures.

Also this module has a one two-hour per weak (compulsory) problem solving in groups. This sessions are held in computer labs and introduce students to mathematical software illustrating the new concepts learnt in lectures. Each group will provide one answer to the exercises proposed to be qualified by the teachers.

Finally, there will be compulsory three one-hour lecture with tutor.

## EVALUATION

The activities of this module are grouped into the following blocks of evaluation:

BLOCK 1.- An examination paper consisting mainly of practical exercises. The mark got in this exam will count 70% of final grade.
BLOCK 2.- Practical activities done along the term by students. The mark obtained will count 20% of final grade.
BLOCK 3.- Interdisciplinary seminars. Alternatively to this activity, it may carry out any other transversal activity, supported
by the CAT as part of a project of educational innovation. The mark obtained will count 10% of final grade.

Each BLOCK will be marked independently and the student will fail if the mark in any of the BLOCKS is less than 4/10.

A student can resit the examination paper of BLOCK 1. The mark got in BLOCK 2 will be maintained in one academic year while the mark got in BLOCK 3 will be maintained in two academic years.

## REFERENCES

### Basic

- R.L. Larson & B.H. Edwards Cálculo 1 , McGraw Hill 2010.
- C. Neuhauser, Matemáticas para ciencias, Prentice-Hall, Madrid, 2004.
- J. Stewart, Cálculo: conceptos y contextos, Tercera Edición, International Thomson, México, 2006.
- D.Z. Zill & W. Wright Cálculo de una variable, McGraw Hill 2011.

### Additional

- S. T. Tan, Applied Calculus for the Managerial, Life, and Social Sciences, 5th Edition, Thomson Learning, Belmont 2002.