Universidad de Navarra

Mathematics (F. Ciencias)
Teaching guide 2026-27

INTRODUCTION

Description: This is a mathematics course with a modelling perspective. We will learn how to use mathematics to model and analyze physical, biological and chemical phenomena. A laptop or tablet will be required for the programming seminars.

- **Degree**: Biochemistry, Biology, Environmental Sciences
- **Module and Subject in the Degree Program**:
  - Biochemistry: Module I. Mathematics, Physics and Chemistry. Subject 1.1 Principles of Mathematics and Physics.
  - Biology: Module I. Mathematics, Physics and Chemistry for Biology. Subject 1.1 Mathematics, Physics and Chemistry.
  - Environmental Sciences: Module I: Scientific Bases of the Environment. Subject 1.1 General Scientific Bases.
- **ECTS**: 6
- **Year and Semester**: First year, first semester.
- **Course type**: Required
- **Instructor**: Sergio Ardanza-Trevijano, Axel Katona.
- **Language**: English
- **Lecture Schedule**: Tuesday 8-10, Thursday 9-10, Friday 11-12

LEARNING OUTCOMES

Biology Degreee

RA2 Apply the bases of Mathematics, Physics, Chemistry, Biostatistics, and Bioinformatics in Biology studies.

Biochemistry degree

RA2 Apply mathematics, statistics, and informatics to obtain, analyze, and interpret data and to develop models of biochemical systems and processes.

Environmental Sciences Degree

RA31 Analyze complex problems from an interdisciplinary perspective, integrating knowledge from different fields to ground proposals or decisions.

PROGRAM

1) Integration.

- Indefinite Integral. Antiderivative and the concept of indefinite Integral.
- Methods of integration. Integration by substitution. Integration by parts. Integration by partial fractions.
- Definite Integral and the Fundamental Theorem of Calculus.
- Improper Integrals

2) Taylor Series and Polynomials.

- Definition of the exponential, sine and cosine functions using power series. Euler-de Moivre formula.
- Sum, difference, product and quotient of power series. Derivative and integral of a power series.
- Taylor polynomial. Approximating functions with Taylor polynomial.

3) Differential Equations.

- Modeling with Differential equations.
- First order ordinary differential equations. Separable Equations.
- Directions Fields and Euler's Method.
- Phase Plot, Equilibria and Stability.

4) Linear algebra and geometry.

- Coordinate systems.
- Vectors and the dot product.
- Linear independence.
- Bases of a vector space.
- Linear maps.
- Matrix Algebra.
- The inverse and Determinant of a Matrix.
- Eigenvectors and Eigenvalues.

5) Multivariable Calculus.

- Functions of Several variables.
- Partial Derivatives.
- Tangent Planes and Linear Approximations.
- The chain Rule.
- Directional derivatives and the Gradient vector.
- Maximum and minimum values.

6) Systems of Differential Equations.

- Qualitative Analysis of Linear Systems.
- Solving Systems of Linear Differential Equations.
- Systems of Nonlinear Differential Equations.

NOTE: Chapters 3-5 in this program corresponds roughly to chapters 7 through 10 of Stewart and Day *Biocalculus: Calculus for Life Sciences*

LEARNING ACTIVITIES

1. THEORETICAL AND PROBLEM SESSIONS . 45 H

- **Methodology:** We start with a motivating example, then proceede to introduce the theoretical concepts which are subsequently applied to the example and other exercises and problems.

2. PRACTICAL SESSIONS, 15 H

- **Methodology:** Students will have to solve problems proposed in class either individually or by groups.

3. COMPUTATIONAL SECTIONS WITH: WOLFRAMALPHA, SAGE and R/Rstudio, 4 H

- Along the course there will be demonstration sessions of how to use the free tools Wolframalpha, Sage and R/Rstudio to find numerical and analytical solutions to problems.

Out of Class

6. PERSONAL STUDY. 75 H

- The students have to go over the material covered in class and assimilate the concepts explained. After reflecting on the theory the students will be able to find the relevant argument for a given practical problem by themselves. They will work with their class notes and the recommended bibliography and solve problems given in class.

EVALUATION

The final grade in December will be the maximum between:

1. 50% Final exam + 30% Midterm exam + 20% Quizzes
2. 80% Final exam + 20% Quizzes

The midterm and the final will have between 2 and 8 exercises.

The **June exam** will have the same format as the final exam, and the **June grade** will be obtained using the pattern above.

Students that repeat the subject might choose to do only the midterm and the final, with a 40% and 60% value in that case, although we strongly recommend to follow the course and do the quizzes. No grades will be kept from previous years.

It is a requirement for passing the subject that the grade in the final exam is greater or equal to 4 before doing the above mentioned calculations.

Plagiarism or cheating will result in a failure. The legal text (in Spanish) concerning this issue is inserted here:

La falta de originalidad o plagio en los trabajos conllevará el suspenso de la asignatura, de acuerdo con la normativa de la Universidad

https://www.unav.edu/documents/10162/32684638/6-normativa-disciplina-academica.pdf

NOTA: Ante la evidencia de un alumno que copia en un examen o comete cualquier tipo de plagio en los trabajos, se le suspenderá la asignatura hasta la siguiente convocatoria

OFFICE HOURS

Sergio Ardanza-Trevijano **(sardanza@unav.es)**

- Location: My office at the Castaños Building, Department of Physics and Applied mathematics.
- Date and hour. Tuesdays from 15:00 to 16:00 or by appointment.

BIBLIOGRAPHY

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Our textbook for this subject will be

Title: Biocalculus: Calculus for the life Sciences.

Authors: James Stewart & Troy Day

Publisher: Cengage Learning; (2015)

ISBN: 9781133109631 Find it in the Library

You can also use the following free resources.

APEX calculus

Active Calculus

Ximera mooculus

We will use several free computer resources

Wolframalpha: https://wolframalpha.com/

Sage http://www.sagemath.org

R https://cran.r-project.org/ and **RStudio IDE** https://posit.co/