

68451 - Introduction to Mathematical and Physical methods in Biology

Syllabus Information

Academic year: 2023/24

Subject: 68451 - Introduction to Mathematical and Physical methods in Biology

Faculty / School: 100 - Facultad de Ciencias

Degree: 626 - Máster Universitario en Biofísica y Biotecnología Cuantitativa / Master in Biophysics and Quantitative Biotechnology

ECTS: 6.0

Year: 01

Semester: First semester

Subject type: ENG/Complementos de Formación

Module:

1. General information

The aim of this course is to give an overview of the main mathematical and physical tools required to develop an abstract thinking and have a proper understanding of concepts that will be used in other subjects of this master's degree. The subject is introduced from basics concepts in order to help those students who haven't had previous math or physics knowledge.

The goals are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/>), in such a way that the acquisition of the learning results of this course provides training and skills to contribute to some extent to its achievement. In particular, we focus on Goal 4: Quality education

2. Learning results

At the end of the course the students should be able to understand the different mathematical tools required to construct the models of biological systems which will appear in the course of *System and synthetic biology* and the physical properties encoded in the different tools described in the course *Simulation of Biomolecules*.

3. Syllabus

Mathematical Methods:

1. Introduction to linear algebra
 - Vector spaces and linear mappings
 - Matrices
 - Eigenvectors and eigenvalues. Diagonalizability
2. Introduction to calculus
 - Functions in one and several variables
 - Continuity and differentiability. Taylor series.
 - Riemann integral
 - Systems of Differential equations
 - Qualitative methods
 - Partial differential equations
3. Introduction to Statistics and Probability
 - Basic probability distributions
 - Descriptive statistics
 - Basis inference: estimation and basic tests

Physical methods

1. Classical Mechanics
 - Newton's laws
 - Hamiltonian mechanics
2. Introduction to Thermodynamics and Statistical Mechanics
 - Basic thermodynamical functions: energy and entropy

- The concept of ensemble
 - Microcanonical and canonical ensembles. The concept of temperature.
3. Introduction to Quantum Mechanics
- The wave function
 - Schrödinger equation
 - The hydrogen atom

4. Academic activities

This is a 6 ECTS course which will be organized in three types of sessions:

- Theory sessions.
- Problem sessions
- Computer laboratory sessions.

From the problem and laboratory sessions the students will have to prepare reports and submit them to be assessed. This part of the students work represents 50% of the final grade.

5. Assessment system

The grading system will be as follows:

1: (50% of the final grade). Continuous evaluation of the student's progress during the practical and theoretical sessions, through the correction of the practice reports, as well as through direct interaction in the classroom, rewarding active participation during the lectures and practices.

2: (50% of the final grade) Written exam, possibly including computer exercises, and/or resorting to the Moodle platform, on the topics discussed throughout the course.