Universidad Zaragoza

Curso : 2019/20

63106 - Modelización biológica

Información del Plan Docente

Año académico: 2019/20
Asignatura: 63106 - Modelización biológica
Centro académico: 100 - Facultad de Ciencias
Titulación: 572 - Máster Universitario en Biotecnología Cuantitativa
Créditos: 4.0
Curso: 1
Periodo de impartición: Segundo semestre
Clase de asignatura: Optativa
Materia: ---

1.Información Básica

1.1.Objetivos de la asignatura

This course explains in detail the main theoretical and computational tools required to model biological systems. From this poir from 63100-Systems Biology and 63101-Simulation of Biomolecules. It has been designed in order:

- To present the main theoretical/computational tools required to explain the experimental data obtained during the stud
- To present the dynamical and thermodynamical description of biological systems, focusing on the the most relevant th
- To introduce the most frequent models for the different scales and processes in the description of biological systems a data.
- To provide the student with an educated criterion to choose the most suitable method to be used in each particular sitı or obtained from the Literature.
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1.2.Contexto y sentido de la asignatura en la titulación

This course covers, with the course in Biostatistics and Bioinformatics, the most theoretical aspects of the program and it is designed to provide those students with interests in the theoretical and computational aspects of Biotechnology with the background required to begin a research career.

1.3.Recomendaciones para cursar la asignatura

Students should have a basic mathematical background in algebra and differential equations, and must have followed the thre

2.Competencias y resultados de aprendizaje

2.1.Competencias

Basic and General

01 - To order, analyze critically, interpret and synthesize information

02 - To obtain information from different types of sources and evaluate their reliability.

03 - To acquire a significant degree of independence.

04 - To formulate, analyze, evaluate and compare new or alternative solutions to different problems.

05 - To communicate results in a clear and unambiguous way, using suitable presentation tools and with the limitations i

At a general level, the main goal of the course is to provide the student with the ability to analyze, critically, the use of computa
course, he/she will be able to design, independently or as part of a team, a simulation of a biological system with the most adec

Specific

1. To learn the basic aspects of the theory of statistical mechanics used in the mathematical description of biological sys

2.- To learn the basic aspects of the theory of stochastic dynamical systems used in the mathematical description of biol

3. To learn to build a theoretical model adapted to the description of experimental data.

4. To learn to use the most relevant simulation techniques and the main approximation methods.

2.3.Importancia de los resultados de aprendizaje

Mastering the different simulation techniques is a basic skill which is essential for a future career as a researcher within this fiel

3.Evaluación

3.1.Tipo de pruebas y su valor sobre la nota final y criterios de evaluación para cada prueba

1: (45% of the final grade). Continuous evaluation of the student's progress by direct interaction in the classroom, rewarding act
by the teacher during the practice sessions.

2: (10% of the final grade). Seminars on papers related to the topics studied

3: (45% of the final grade) Written exam.

4.Metodología, actividades de aprendizaje, programa y recursos

4.1.Presentación metodológica general

The learning process designed for this course is based on a combination of lectures, exercises and practice sessions in the cor notes, as well as to propose exercises and tests. Students are encouraged to present a short seminar so as to train their organi throughout the semester. We will promote the debate and the active participation of the students throughout all the activities.

4.2.Actividades de aprendizaje

The course includes the following learning tasks:

- Lectures. The lecturer provides theorems and examples, organized according to the syllabus of the course.
- Practice sessions. Students can apply and consolidate the theoretical understanding by means of relevant examples and prob
- Computer programming of problems. They extend the scope of the classroom exercises to the cases where computations bec
- Assignments for the students interested in deepening their understanding in specific topics.

Course material: Notes written by the teachers will be available on the course's Moodle page.

4.3.Programa

The course will address the following topics:

1. Statistical mechanics models I: canonical and microcanonical ensembles.
2. Statistical mechanics models II: Cooperativity and the Helix-Coil transition.
3. Statistical mechanics models III: Models of biopolymers.
4. Statistical mechanics models IV: Coarse graining and force fields.
5. Stochastic models I: Brownian motion and diffusion.
6. Stochastic models II: Langevin and Fokker-Planck equations.
7. Stochastic models III: Chemical master equation and Gillespie algorithm.
8. Stochastic models IV: Kramers theory in chemical kinetics.
9. Simulation techniques: Monte Carlo methods and applications.

4.4.Planificación de las actividades de aprendizaje y calendario de fechas clave

The course takes place during the second semester of the academic year. Lectures will be held on Tuesdays and Practice Ses
Homework and other assessment tests will be proposed to the students throughout the semester.
The course is taught throughout the second semester (February-June)
Examinations: one exam at the end of the semester

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4.5.Bibliografía y recursos recomendados

Teachers will provide some original research papers to work with and original course notes. Other useful references may be, ar

- Mathematical Modeling in Systems Biology: An Introduction
  Brian Ingalls, MIT Press 2013
- Notes on Mathematical Systems Biology, E. Sonntag, Rutgers University (http://sites.math.rutgers.edu/~sontag/FTPD
- Differential Equations and Mathematical Biology, 2nd Edition, CRC Press, 2009