COURSE DATA

DATA SUBJECT

Code: 42589
Name: Computational systems biology
Cycle: Master's Degree
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2116 - Master's Degree in Bioinformatics	Escola Tècnica Superior d'Enginyeria	2	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2116 - Master's Degree in Bioinformatics	Computational systems biology	COMPULSORY

COORDINATION

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SUMMARY

It is important for the bioinformatician to be familiar with the concepts of Systems Biology and to understand the cell as a set of elements that interact with each other in different ways to carry out functions. Systems Biology combines the processing of massive amounts of data, network thinking and modeling of dynamic systems. This course is an introduction to the computational handling of data to obtain biologically relevant information.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Graph theory. Basic concepts in biochemistry (metabolism, intra- and intercellular signaling), molecular

biology (macromolecule structure and interactions) and molecular genetics

COMPETENCES / LEARNING OUTCOMES

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Adquirir los conocimientos para manejar datos en forma de red e integrar datos ómicos en redes así como modelar tanto redes conocidas (p. ej. pathways) como redes nuevas descritas en estándares como SMBL.

Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.

Be able to access to information tools in other areas of knowledge and use them properly.

Desarrollar la iniciativa personal y ser capaces de realizar una toma rápida y eficaz de decisiones en su labor profesional y/o investigadora.

Manejar conceptos de biología de sistemas y entender la célula como un conjunto de elementos que interactúan para llevar a cabo funciones.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.

Trabajar en equipo con eficiencia en su labor profesional y/o investigadora y con personas de diferente procedencia.

DESCRIPTION OF CONTENTS

1. Introduction to Systems Biology.

Basic concepts and critical analysis of the main ways of studying complex biological systems. Dynamic

networks and models. Concept and classes of models. Robustness and fragility of biological systems. Systems biology standards (SMBL). Tools for visualization and analysis of biological networks

2. Modelling of dynamic systems.

Dynamic modeling of biological circuits (ODEs). Steady states and stability. Examples of functional circuit models: homeostatic, reversible and irreversible switches, oscillating responses.

3. Biological networks.

Introduction to metabolic databases. Stoichiometric analysis and modelling based on constraints. Genome-scale models. Boolean signalling models. Functional analysis: Perturbation studies with mutations.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	21,00
Laboratory	9,00
Total hours	**30,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	5,00
Individual or group project	5,00
Independent study and work	46,00
Preparation of lessons	27,00
Preparation for assessment activities	12,00
Resolution of case studies	18,00
Total hours	**113,00**

TEACHING METHODOLOGY

MD1 - Task training of the teaching-learning environment interaction in the classroom through expository sessions. Previous assignments include preparation (information search, reading texts supplied by teachers), teaching sessions themselves and the later work of deepening.

MD2 - Learning through problem solving and case studies, through which it is acquiring skills on different aspects of materials and subjects.

MD3 - Activities labs. Include preparation, implementation of the monitoring practices and teacher support, online freelance work and reporting practices.

MD4 - Cross-disciplinary skills. Include attendance at courses, conferences or round tables organized by the CEC of the Master and / or conduct of a bibliographic work on issues that contribute to the integral. It produces a report of activities.

EVALUATION

The different contents of the course will be assessed through continuous assessment tasks via online activities (15% of the total mark), the presentation of reports or papers on problems, case studies, and cross-disciplinary activities (30%), and reports or papers on laboratory work (55%). Each task will have a corresponding deadline for the first and second call.

In the case of practical sessions and seminars, attendance will be recorded. Tasks associated with practical sessions cannot be submitted unless 75% of the sessions corresponding to the task have been attended. It is understood that if the assignment is associated with a single practical session, attendance at that session is required. The grading of assignments associated with seminars that have not been attended will be weighted by a factor of 0.5.

REFERENCES

- Davies JA (2028) Synthetic Biology. A very short introduction. Oxford University Press.
- Sauro HM (2014) Systems Biology. Introduction to Pathway Modeling. Ambrosius Pub.
- Voit, E (2017) A First Course in Systems Biology. CRC Press.
- Voit, E (2020) Systems Biology. A very short introudction. Oxford University Press