Universitat de Lleida

DEGREE CURRICULUM

SYNTHETIC BIOLOGY IN BIOMEDICINE

Coordination: VAQUEIRO DE CASTRO ALVES, RUI CARLOS

Academic year 2023-24

SYNTHETIC BIOLOGY IN BIOMEDICINE 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>SYNTHETIC BIOLOGY IN BIOMEDICINE</td></tr>
<tr><td>Code</td><td>101526</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Biomedical Sciences</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>4</td><td>2</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>VAQUEIRO DE CASTRO ALVES, RUI CARLOS</td></tr>
<tr><td>Department</td><td>BASIC MEDICAL SCIENCES</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>H Presencials 60
H. No Presencials 100
Tipus Act.
Presencial 60h
Magistral 3h
Pràctica 50h
Seminari 7h</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Anglès</td></tr>
</table>

SYNTHETIC BIOLOGY IN BIOMEDICINE 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
VAQUEIRO DE CASTRO ALVES, RUI CARLOS	rui.alves@udl.cat	7,2	

Subject's extra information

Contextualization within the degree

Synthetic Biology is an optional course for the third and fourth year of the Degree, taught in the first semester of the academic year. This course aims to provide students who already have an introductory knowledge in Biotechnology, Bioinformatics and Systems Biology with the necessary knowledge to understand and apply the concepts underlying Synthetic Biology. We will discuss the theoretical grounds underlying many examples of Synthetic Biology in biotechnology and biomedicine. Students will use this knowledge to identify a problem that can be solved using synthetic biology methods. Then they will write a project, following the standards of a national competitive project call, to develop that project. This meets some of the current concerns of the occupability surveys run by AQU for Biotechnological Degree holders. Having approved Bioinformatics is a requirement for registration to this course.

In addition to facilitating the acquisition of basic transversal competences, students are also expected to acquire terminological competences and the basic concepts of Synthetic Biology. They will acquire or improve their communication skills, teamwork skills and become capacitated in the use of ICT (Information and Communication Technologies).

This signature will also contribute to students gaining the ability to self-educate, as they will need to do a variety of out-of-class work and freelance activities.

The student is required to be present in 80% of classes to pass the Course.

Learning objectives

See Competences

Competences

Basic skills

CB1 That students have demonstrated that they have and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study

CB2 That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the development and defense of arguments and problem solving within their area of study

CB3 That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature.

CB4 That students can transmit information, ideas, problems and solutions to both specialized and non-specialized

audiences.

CB5 That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

General Competences

CG1. Have a correct oral and written expression

CG2 Master a foreign language.

CG3 Master ICT

CG4 Respect the fundamental rights of equality between men and women, the promotion of Human Rights and the values of a culture of peace and democratic values.

CG5 Apply the gender perspective to the tasks of the professional field

Specific Competences

CE11. Describe the mechanisms of storage and processing of genetic information, as well as the different levels of organization of the human genome.

CE13. Critically evaluate the biomedical literature in relation to design, statistical analysis and interpretation of results, as well as know how to interpret risk and association measures, confidence intervals and statistical significance.

CE14. Design simple studies and analyze the results according to the proposed objectives.

CE15. Differentiate the biology of microorganisms in their structural, physiological and genetic aspects, as well as their diversity.

CE16. Describe the main infectious agents and their mechanisms of action.

CE17. Apply basic techniques for handling microorganisms.

CE18. Critically evaluate and use clinical and biomedical information technologies and sources to obtain, organize, interpret and communicate clinical, scientific and health information

CE19. Use laboratory material and apply basic laboratory techniques.

CE44. Describe the structure, properties, and levels of organization of DNA and RNA.

CE45. Define the molecular bases and mechanisms of the flow of genetic information and its regulation.

CE47. Assess the techniques of analysis of the structure and expression of genomes.

CE48. Assess the techniques of studying the cellular proteome.

CE49. Evaluate the study techniques of cellular metabolites.

CE50. Distinguish the singularities of molecular genetic analysis and its biotechnological and biomedical implications.

CE51. Define the fundamentals and apply the methodology used in the genetic modification of organisms.

CE53. Correctly apply the legal bases and principles of bioethics related to the development and application of molecular and cellular methodologies in the practice of biomedical sciences and life sciences.

CE54. Recognize and apply measures to avoid ecological-environmental problems in the development and application of life sciences

CE55. Use the different bioinformatics tools to extract information from databases in relation to the structure and function of genes and proteins, and know the methods of sequence comparison and comparison between different genomes.

CE60. Apply the basic methods of Molecular Biology used in biomedical research

CE61. Differentiate the technical and methodological means used in Biomedical research

CE69. Apply transversally the knowledge and skills acquired in problem solving.

CE72. Adequately use the scientific and technical vocabulary of the different fields of biomedical sciences. Be able to make comprehensible written reports, with a justification based on the theoretical and practical knowledge achieved.

CE75. Describe the fundamental principles of systems biology and be able to guide the reasoning about a research problem by interrelating the genomic, proteomic and metabolomic levels.

CE76. Define the concept of a mathematical model of a system and its role in the evaluation of hypotheses about the integration of the different elements that make up the system under study.

CE77. Recognize the importance of dynamic aspects in the evaluation of metabolic problems, with special attention to the role of simulation in the evaluation of models.

Subject contents

Unit 1: Introduction to Synthetic Biology

What is Synthetic Biology?

Synthetic Biology as a way to test and improve our understanding of biology

Synthetic Biology as a way to create biomedical and biotechnological aplications

Unit 2: Flavors of Synthetic biology

- **Classical synthetic biology**
  - **Design of standard biological parts**
  - **Design of circuits and organisms with standard behavior**
- ***Synthetic genomics***
  - ***De novo synthesis of genomes***
  - ***Design of new genetic codes, using non traditional base pairs and/or coding for non traditional amino acids***
- **Synthetic morphology**
  - **Redesign of biological tissues and organisms' shape**
- **Synthetic ecology**

Unit 3: Open source tools for Synthetic Biology

Define in silico projects for the iGEM competition Prepare in silico projects for the iGEM competition Identification of systems and organisms to use Identification of the biological parts to use

Unit 4: Student Projects

Development, presentation and evaluation of student projects

Methodology

This course will have a maximum of 15 students. This allows you to do it in person. If the situation COVID19 worsens, the course will be done in semi-face-to-face mode, via virtual campus.

Development plan

This is a Compressed Course, running for one month at the begining of the semester in 3h sessions.

Session plans

Session 1 - Theoretical Seminar, presenting all the material that are needed for the course.

Sessions 2-4 - Preparation of Initial Project Ideas by Individual Students

Session 5 - Presentation and selection of student projects for further development

Session 6 - 15 Development of student projects in small groups

Session 16 Mid-Development presentation of projects

Session 17-19 Final development of projects

Session 20 - Final presentation of projects

Evaluation

The final grade will be the sum of the following aspects:

Initial presentation of individual student ideas (10% of the final grade)

Intermediate presentation of student projects selected for further development (15% of the final grade)

Final presentation of the project (20% of the final grade)

Final Project written for a Competitive Project Call (50% of the Final Grade)

The completion and participation in all the activities scheduled will represent 5% of the final grade.

At least 6 out of 10 must be obtained in each assessment to pass the course.

Alternative assessment:

In the event that the student cannot carry out the continuous assessment due to any of the cases included in the UdL assessment regulations, s/he must inform the teacher during the first week of classes.

In this case the student will be able to carry out a single assessment at the end of the subject, making a final project presentation, with questions and handing in the written project at the same time. The presentation will count 30% of the grade and the project the remaining 70%.

Bibliography

Llibres i articles

Salvado B, Karathia H, Chimenos AU, Vilaprinyo E, Omholt S, Sorribas A, Alves R., Methods for and results from the study of design principles in molecular systems. Math Biosci. 2011

Savageau, M. A. (2010) Biochemical Systems Analysis: A Study of Function and Design in Molecular Biology, CreateSpace Press

Alon, U. (2006) An Introduction to Systems Biology: Design Principles of Biological Circuits Chapman and Hall/CRC

Carlson, R. H. (2011) Biology Is Technology: The Promise, Peril, and New Business of Engineering Life. Harvard University Press

Recursos Web:

http://ung.igem.org/Main_Page

http://en.wikipedia.org/wiki/IGEM

http://partsregistry.org/Main_Page

http://biobricks.org/