DEGREE CURRICULUM

SYNTHETIC BIOLOGY IN BIOMEDICINE

Coordination: VAQUEIRO DE CASTRO ALVES, RUI CARLOS

Academic year 2020-21

SYNTHETIC BIOLOGY IN BIOMEDICINE 2020-21

Subject's general information

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<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>PRIMER QUADRIMESTRE</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><th>Number of credits</th><td>4</td><td>2</td></tr>
<tr><th>Number of groups</th><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>
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SYNTHETIC BIOLOGY IN BIOMEDICINE 2020-21

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
VAQUEIRO DE CASTRO ALVES, RUI CARLOS	rui.alves@udl.cat	6	

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

Competence 1 Ability to design simple studies, and analyze and interpret the results in accordance with the objectives set.

Goals

- **Provide scientific training in all facets related to the biomedical sciences.**
- **Develop the attitudes and aptitudes needed to be able to act widely in biomedical research.**
- **Provide future biomedical professionals with extensive knowledge in basic sciences, techniques and methods of biomedical research, organization and management of research, legal and ethical aspects of research, public health, languages and other complementary subjects.**

• Recognize their own limitations and the need to maintain and update their professional competence, paying special attention to autonomous and continuous learning, new knowledge, products and techniques in biomedical research, as well as motivation for quality.

• Interpret the results and observations of biomedical science research projects.

• Acquire basic training for research activity, with the ability to formulate hypotheses, collect and interpret information for solving problems using the scientific method. Understand the importance and limitations of scientific thinking in health and biomedical matters.

• Understand and know how to apply the concepts specified in the theoretical program.

• Understand the terminology and basic scientific language related to systems biology and synthetic biology.

• Know how to use the concepts related to the thematic contents to carry out the proposed evaluation work and interpret the results obtained.

• Know how to identify which tools to use once the biological problem is defined.

• Learn how to use these tools autonomously.

Competence 2 Recognize and know how to apply measures to avoid ecological and environmental problems in the development and application of life sciences.

Goals

• Understand and know how to apply the concepts specified in the theoretical program, especially in topics 2, 3 and 4.

• Know how to use the concepts related to the thematic contents to critically evaluate the various tools available to carry out the firm's projects and their limits.

• Know how to write scientific articles.

Competence 3 To know, critically evaluate and know how to use the technologies and sources of clinical and biomedical information to obtain, organize, interpret and communicate clinical, scientific and health information.

Goals

• Understand and know how to apply the concepts specified in the theoretical program.

• Know how to use the concepts related to the thematic contents to critically evaluate the various tools available to carry out the same work and its limits.

• Know how to write scientific articles.

Competence 4 Understand, know how to apply and perform the techniques for analyzing the structure and expression of genomes, of the cell proteome.

Goals

• Know and apply the concepts specified in Topic 1, 2, 3, and 4 of the theoretical program.

Successfully carry out the work defined by the evaluation of these concepts.

Competence 5 To be able to use the different bioinformatics tools to extract information from databases regarding the structure and function of genes and proteins, and to know the methods of sequence comparison and comparison between different genomes.

Goals

• Understand and know how to apply the concepts specified in the theoretical program.

Competence 6 Induce strategies for the design of anti-infectious drugs.

Goals

• Understand and know how to apply the concepts specified in the theoretical program, more specifically, in Topics 1, 2 and 3.

Competence 7 Understand the concept of a mathematical model of a system and its role in evaluating the hypothesis about the integration of the different elements that make up the system under study.

Goals

• Understand and know how to apply the concepts specified in the theoretical program, more specifically, of the Topics described below.

Competence 8 Understand the importance of dynamic aspects in the evaluation of metabolic problems, with special emphasis on the role of simulation in the evaluation of models.

Goals

• Know and apply the concepts specified in the theoretical program.

Competence 9 Understand the fundamental principles of systems biology and be able to guide reasoning about a research problem by interrelating genomic, proteomic and metabolomic levels.

Goals

• Know and apply the concepts specified in the theoretical program.

SYNTHETIC BIOLOGY IN BIOMEDICINE 2020-21

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.

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/