Future, emerging technologies

Academic Year: (2023 / 2024) **Review date: 19-09-2022**

Department assigned to the subject: Bioengineering Department

Coordinating teacher: RIO NECHAEVSKY, MARCELA ANDREA DEL

Type: Compulsory ECTS Credits : 4.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Bachelor courses closely related to Biochemistry and/or Cellular and Molecular Biology.

OBJECTIVES

BASIC COMPETENCES

CB6. Acquire knowledge and understanding to provide the basis to develop and/or apply original ideas, often in a research context.

CB7. Apply the acquired knowledge and the ability to solve problems in new contexts within broader (or multidisciplinary) contexts related to their field of study.

CB8. To be able to integrate the acquired knowledge and handle complexity of formulate judgments based on incomplete or limited information, including reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9. To be able to communicate their conclusions and thoughts to a specialized and non-specialized audience in a clear and unambiguous manner.

CB10. Learn skills that will enable the students to continue their studies.

GENERAL COMPETENCES

CG1. Achieve a multidisciplinary scientific view, with a clear translational orientation and applied to the field of biomedical science and technology.

CG2. Demonstrate a deep theoretical and practical knowledge about both the principles and the most advanced technologies in biomedical sciences.

CG3. Ability to lead and manage groups and research teams and also to promote teamwork, knowledge management and competitive intelligence.

CG4. Ability to analyze, synthesize and apply knowledge to propose original solutions to biomedical problems.

CG5. Develop abilities to identify and understand the social needs and to provide scientific and technological solutions in the biomedical field.

CG6. Identify the keys of technology transfer in the Spanish and in the EU market, and understand the basis for the management and building of a biomedical based company.

SPECIFIC COMPETENCES

CE3. Understand the fundamentals of different genetic tools used for the modification of celular genomes, know how to use them and their clinical application.

CE6. Learn how and when to apply omic and bioinformatic technologies in the biomedical field specifically for the identification of new targets and the development of new drugs and diagnostic methods.

LEARNING RESULTS

1. Understand how integrated systems work: understand the global picture of biology.
2. Knowledge on the basic fundamentals of design, implementation, testing and optimization of living organisms.
3. Ability to model complex biological systems.
4. Understand the basis of cyborg tissues and cells, and their applications in the new Medicine. Tissues and cells responsive to illness and damage.
5. Apply the acquired knowledge to the Biomedical Technologies field.

DESCRIPTION OF CONTENTS: PROGRAMME

The students will understand the basis of a series of technologies (some of them extremely novel) related to biomedical research. Systems and Synthetic biology are considered the cornerstones of future biomedicine. Also, there are new cyborg tissues with improved mechanical properties at a very

low cost, and it is also a reality nowadays the generation of cells that carry microsensors (such as pressure and temperature) that allow to measure in real time the cellular behaviour against various stimuli and treatments.

"Emergent technologies" programme:

a. Synthetic biology: the new paradigm of bioengineering
b. Gene synthesis and DNA assembly. Design of genetic circuits. Cell communication and signaling transduction engineering.
c. Applications of synthetic biology. Metabolic engineering.
d. Machine-human hybrid systems with augmented capacities. Cyborg cells and tissues.
e. Systems biology: in silico biology. Genomic scale models and minimal models. Applications to the design of new drugs.
f. Biological network analysis: cancer as an example.
g. Microfabrication and tissue bioprinting

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES
- Theoretical classes
- Theoretical-practical classes
- Tutorships
- Group work
- Student´s individual work

TEACHING METHODOLOGIES
- Teacher explanations supported with audiovisual media and information technology, in which the main concepts of the subject are developed and the reference literature is provided to supplement student learning.
- Critical reading of international references recommended by the professor: journal papers, reports and manuals for further discussion in class, to enhance and consolidate the knowledge acquired.
- Solving practical biomedical cases, presented by the professor to the students either individually or in groups.
- Presentation and discussion in class, under the moderation of the professor, of subjects related to the course.
- Reports and projects (working individually or in groups).

ASSESSMENT SYSTEM

Attendance to 80% of sessions is mandatory to be evaluated.

CONTINUOUS EVALUATION: there are two main projects, one related to Synthetic Biology and the other to Systems Biology. Both of them have the same value and account for the 50% of the final mark of the course.

FINAL EXAM: The final exam will include all the topics from the course (including presentations and working projects), and will represent 50% of the final mark. The minimum score in the final exam to pass the subject is 4 over 10, notwithstanding the mark obtained in continuous evaluation.

EXTRAORDINARY EXAM: the mark of the final additional exam would be: a) 100% of the exam, or b) 40% of the additional exam and 60% of the continuous evaluation if it is available on the same course and if the student requests it (and if the student has at least a 4 over 10 in the extraordinary exam).

ACADEMIC CONDUCT: Unless otherwise specified, the tests will be closed book, no computer or phone, or anything else other than a writing instrument and the examination itself. Plagiarism, cheating or other acts of academic dishonesty will not be tolerated. Any infringement of any kind will result in a failing grade.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- AL Barabasi Network Science, Cambridge University Press, 2016

- Marcus W Cobert Fundamentals of Systems Biology: From Synthetic Circuits to Whole-cell Models, CRC Press, 2015

- Singh V. and Dhar P. Systems and Synthetic Biology, Springer, 2014