Synthetic and systems biology

Academic Year: (2022 / 2023) **Review date: 23/05/2022 12:52:12**

Department assigned to the subject: Bioengineering Department

Coordinating teacher: LEON CANSECO, CARLOS

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

It is strongly advised to have completed Cell and Molecular Biology, Biochemistry, Bioinformatics.

OBJECTIVES

Fundamental knowledge and capabilities developed by cellular engineering scientists allows us to move beyond toward systematic mechanisms for predictable modulation of cell proliferation, migration, communication, and the production of small molecules and biologics. Modern biomedical science includes Systems Biology and Synthetic Biology, two new and complementary fields that constitute the basis of innovation. In this course, students will learn about the foundational technologies and theory behind engineering biology. Students will study strategies for engineering cellular and molecular systems as well as, will explore current and future applications for synthetic biology and system biology approaches. Students will study how to build novel synthetic biological systems that solve practical biomedical problems. They will incorporate elements from many different disciplines including chemistry, biology, mathematics, physics and engineering.

DESCRIPTION OF CONTENTS: PROGRAMME

Gene and protein sequencing, gene expression analysis, protein expression and interaction analysis, genomic and proteomic analysis . protein-protein Interaction networks, metabolic networks and disease networks, quantitative tissue analysis, modeling biological systems: synthetic biology circuits, data analysis techniques and clinical computing interfaces.

The course is divided mainly in two parts:

SYSTEMS BIOLOGY AND OMIC TECHNOLOGIES:

- Fundamentals of genomics, proteomics and metabolomics
- How do normal cellular functions such as cellular division, cell activation, differentiation, and apoptosis emerge from the interaction of genes
- How to examine whole cell functions corresponding to observable phenotypes.
- How to generate network reconstructions, followed by the synthesis of in silico models describing functionalities.
- Systems Analysis of Complex Diseases.
- Systems Pharmacology: Understanding Drug Action from a System Perspective.
- Systems Pharmacogenomics: Personalized medicine.

SYNTHETIC BIOLOGY:

- Design and construction of new biological parts, devices, and systems, and the re-design of existing natural biological system for better application.
- Build artificial biological systems for engineering applications.
- Draw powerful techniques for the rapid assembly of DNA.
- Engineer biological system: modify the behaviour of organisms and engineer them to perform new tasks. Create bioengineered microorganisms that can produce pharmaceuticals and repair damaged genes.

LEARNING ACTIVITIES AND METHODOLOGY

The program will be divided into master classes and computer practical classes (cases). Students are required to read or resolve assigned chapters, articles, problems, etc., before the corresponding classes. The seminars will contain the discussion of relevant scientific articles and problems that will be presented by the students.

ASSESSMENT SYSTEM

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

Teaching methodology will be mainly based on lectures, seminars and practical sessions.
Students may be required to read assigned documentation before lectures and seminars. Lectures will be used by the teachers to stress and clarify some difficult or interesting points from the corresponding lesson, previously prepared by the student.
Grading will be based on two continuous evaluation practices and several exercises, together with a final exam covering the whole subject. Help sessions and tutorial classes will be held prior to the final exam upon student's request.
Attendance to lectures and seminars is not compulsory. However, failure to attend any test will result in a mark of 0 in the corresponding continuous evaluation block (see below).

GRADING:
Total score: 10 points
Continuos evaluation: 5 points out of 10 (project poster 2.5 points, project paper discussion 1.5 points and exercises 1 point)
Final exam: 5 points out of 10
FINAL EXAM: The final exam will cover the whole subject (and may include practical cases) and will account for the 50 % of the final score. The minimum score in the final exam to pass the subject is 4 over 10, not with standing the mark obtained in continuous evaluation.
EXTRAORDINARY EXAM: The mark for students attending any extraordinary examination will be:
a) 100% exam
b) 50% exam and 50% continuous evaluation if it is available in the same course
ACADEMIC CONDUCT: Unless specified all exams will be closed-book, closed-notes, no PC or mobile phone, or anything else other than a writing implement and the exam itself. Plagiarism, cheating or other acts of academic dishonesty will not be tolerated. Any infractions what so ever will result in a failing grade.

BASIC BIBLIOGRAPHY

- Natalie Kuldell PhD., Rachel Bernstein, Karen Ingram, Kathryn M Hart Synthetic Biology in the Lab, BioBuilder, June 2015

- Uri Alon An Introduction to Systems Biology: Design Principles of Biological Circuits , Chapman & Hall/CRC Mathematical and Computational Biology, Jul 2006