UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Synthetic Biology for Microbial Biotechnology

2324-1-F0802Q083

Aims

The educational objective of the course is to introduce the student to the topics and provide the general principles of synthetic biology, as well as a series of basic methodological tools that can be applied in order to redesign and produce (Synthetic Biology) biological systems (e.g. genetic circuits based on DNA or RNA) already present in nature or to design and manufacture biological components and systems that do not yet exist, for biotechnological applications in the field of industrial microbiology and in particular of *Biomanufacturing*.

The **predominant practical part** , which will take place in the laboratory (IT lab and molecular biology lab) aims at generating at least one system deriving from the application of synthetic biology tools.
Furthermore, the students will be introduced to planning of experiments, management and use of laboratory instruments and analysis of the results obtained during the lab work.
principali
On completion of the course, the student should be able to:

- account for central methods and tools in synthetic biology
- plan and carry out basic experiments in synthetic biology using a safe and scientifically based way of working
- in writing and orally present and explain the planned and completed experiments and methods of the course

Contents

The basic principles of Synthetic Biology are: (i) the use of standardised and well characterised building blocks, (ii) the hierarchical design of nature-inspired, artificial genetic circuits and proteins in silico, and (iii) the use of chemically synthesized DNA sequences not found in nature.
During lectures the students will learn the basic technologies to build genetically modified microorganims and how

to design and analyze synthetic biology systems for bioproductions.
During the practical laboratory experience, the students will design with informatics tools the genetic material and the genetic modifications that will be introduced in a selected GRAS microorganism during the wet-lab sessions. In addition, the novel functions of the generate microorganism will be analysed by setting up cultures in flasks or controlled bioreactors.

Detailed program

About Synthetic Biology and its application in the field of Biomanufacturing with microorganisms
Quick review of relevant cellular processes
DNA Assembly, genome editing and whole genome engineering (modular cloning and CRISPR-Cas)
Parts and composition I: What are parts and how do they connect?
Parts and Composition II: Gene expression and regulation, composition into cascades
Toggle Switch
Oscillators
RNA Devices
RNA Devices and Circuits: MiRNA and RBPs, rCas9
Protein-Protein Circuits
Biological synthesis of novel compunds: "*new to biochemistry*"

Prerequisites

Basic knowledge in molecular biology and microbiology.

Teaching form

The course will be largely practical.

In particular, the course will consist of **14 hours of frontal lessons** in which the fundamental concepts and tools of synthetic biology will be introduced and explained and of **40 hours of practical activity** in the laboratory in which some tools of synthetic biology will be applied and the results will be analyzed on microbial cultures.

Textbook and teaching resource

Semester

First semester

Assessment method

The participation to laboratory sessions is rquired to achieve a positive assessment.
In addition, the students are required to make a written report (e.g. design and analyze a novel biological system or to analyze an existing biological system (synthetic or natural) in depth in a novel way") that will be assessed during an oral exam session.

Office hours

By appointment

Sustainable Development Goals

QUALITY EDUCATION | RESPONSIBLE CONSUMPTION AND PRODUCTION