COURSE DESCRIPTION
SYSTEMS AND SYNTETHIC BIOLOGY

SSD: BIOINGEGNERIA INDUSTRIALE (ING-IND/34)

DEGREE PROGRAMME: BIOINGEGNERIA INDUSTRIALE (P16)
ACADEMIC YEAR 2023/2024

COURSE DESCRIPTION

TEACHER: DI BERNARDO DIEGO
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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U5489 - MICROFLUIDICS AND SYSTEMS AND SYNTHETIC BIOLOGY
MODULE: U1577 - SYSTEMS AND SYNTETHIC BIOLOGY
TEACHING LANGUAGE: INGLESE
CHANNEL: FG A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

Systems Analysis for BioEngineering
Cell and Molecular Biology

PREREQUISITES

none

LEARNING GOALS

Systems Biology studies biological systems from an engineering viewpoint to achieve a quantitative understanding of their function. Synthetic Biology aims at engineering living systems for biotechnological and biomedical applications. The course will introduce students to the fundamental concepts and engineering methods of Systems and Synthetic biology, by means of representative examples in the biomedical and biotechnological areas.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student will learn the basic biomolecular circuits that are present in a cell and how these are able to perform specific functions (logic function, oscillators, memory elements, controllers, etc.). The student will learn how to model this circuit using linear and non-linear dynamical systems and study their behaviour with analytical, qualitative and numerical methodologies.

Applying knowledge and understanding

The student will be able to model existing biomolecular circuits in the area of Systems Biology and to desing novel biomolecular circuits to perform specific functions in the cell in the framework of Synthetic Biology.

COURSE CONTENT/SYLLABUS

Introduction to biological networks. Nonlinear modelling of biological systems. Modelling of biological “parts”: promoters, sequence “tags” for degradation and localisation, microRNAs, Transcription Factors, Kinases &Phosphatases. Modelling synthetic networks: the Positive Feedback Loop, the Negative Feedback Loop, The Toggle switch, the Repressilator and other biomolecular clocks, The Antithetic Integral Controller. Experimental methods for quantitative characterisation of biological circuits.

READINGS/BIBLIOGRAPHY

Lecture Notes available in PDF on the TEAMS course page.
(optional) Book: Introductionto Systems Biology, B. Ingalls.

TEACHING METHODS OF THE COURSE (OR MODULE)

The course will consists of lectures using lecture handouts and PowerPoint presentations, and of practical sessions to solve problems using "pen and paper"; a computer with MATLAB for numerical simulations; and a computer with the open source GRO software for agent-based modelling of bacterial cells.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☑ Numerical exercises

b) Evaluation pattern