

EE-490(j)

**Lab on cell-free synthetic biology**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA1, MA3	Opt.
Life Sciences Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Withdrawal Session	Unauthorized Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
TP	4 weekly
<b>Number of positions</b>	<b>16</b>

**Il n'est pas autorisé de se retirer de cette matière après le délai d'inscription.**

**Summary**

The cell-free synthetic biology course introduces engineers to the most commonly used techniques required to conduct work in Biotechnology and Bioengineering. Additionally, this course is an experiment in democratizing education and open science by generating useful resources for the local community

**Content**

Note: this course is limited to a maximum of 16 students

The hands-on Cell-free synthetic biology laboratory course will introduce engineering students to fundamental methods and techniques commonly used in Biotechnology and Bioengineering. In this course the students will generate a cell-free transcription and translation system called the PURE system, which entails learning and performing polymerase chain reactions (PCRs), protein overexpression, protein purification, and other important molecular biology techniques. The students will then assess the functionality of their PURE systems by quantifying the expression of a green fluorescent protein (GFP).

Cell-free systems are becoming exceedingly powerful and therefore popular tools in biotechnology, bioengineering, and synthetic biology. In one recent example the 2019 EPFL iGEM team who won the iGEM competition that year, developed a cell-free molecular diagnostic kit for the identification and differentiation of two grapevine diseases (see first link below). In addition, we have shown in the past that cell-free systems are ideal tools for education and teaching by providing local high-schools with cell-free educational kits (see second link below). The cell-free synthetic biology course is therefore exploring the possibility to leverage the ample resources available in higher education to generate an additional, synergistic benefit for the population. We are hoping that with this course we will be able to sustainably produce cell-free educational kits for use in local schools.

The cell-free synthetic biology course will consist of a couple of introductory lectures, followed by laboratory experiments. The students will be guided through all the required steps required for each specific method and technique to generate functional cell-free systems (see third link below for a video guided tutorial published by our laboratory describing the steps required to generate a cell-free system). At the end of course, if we succeeded to produce functional cell-free systems we plan to package them into kits together with the students of the class and distribute them to interested local high-schools for their use in their biology curriculum.

**Keywords**

molecular biology  
laboratory techniques and methods  
biotechnology  
bioengineering  
synthetic biology  
cell-free synthetic biology

democratizing education  
open science

## Learning Prerequisites

### Required courses

There are no pre-requisite courses.  
No prior experience or background in biology is required.

### Recommended courses

EE-526 Introduction to Bioengineering

## Learning Outcomes

By the end of the course, the student must be able to:

- Analyze experimental outcomes
- Carry out out molecular biology techniques
- Conduct molecular biology experiments
- Quantify the functionality of a cell-free system
- Create cell-free systems

## Transversal skills

- Use a work methodology appropriate to the task.
- Negotiate effectively within the group.
- Keep appropriate documentation for group meetings.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate the capacity for critical thinking
- Collect data.
- Write a scientific or technical report.

## Teaching methods

The course will be primarily hands-on experimental work, with real-time instructions and feedback.

## Assessment methods

Students will be assessed by their ability to conduct molecular biology experiments, maintain a laboratory notebook, critically assess and report the outcomes of experiments, and work in a team.

## Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

## Resources

### Moodle Link

- [https://go.epfl.ch/EE-490\\_j](https://go.epfl.ch/EE-490_j)

